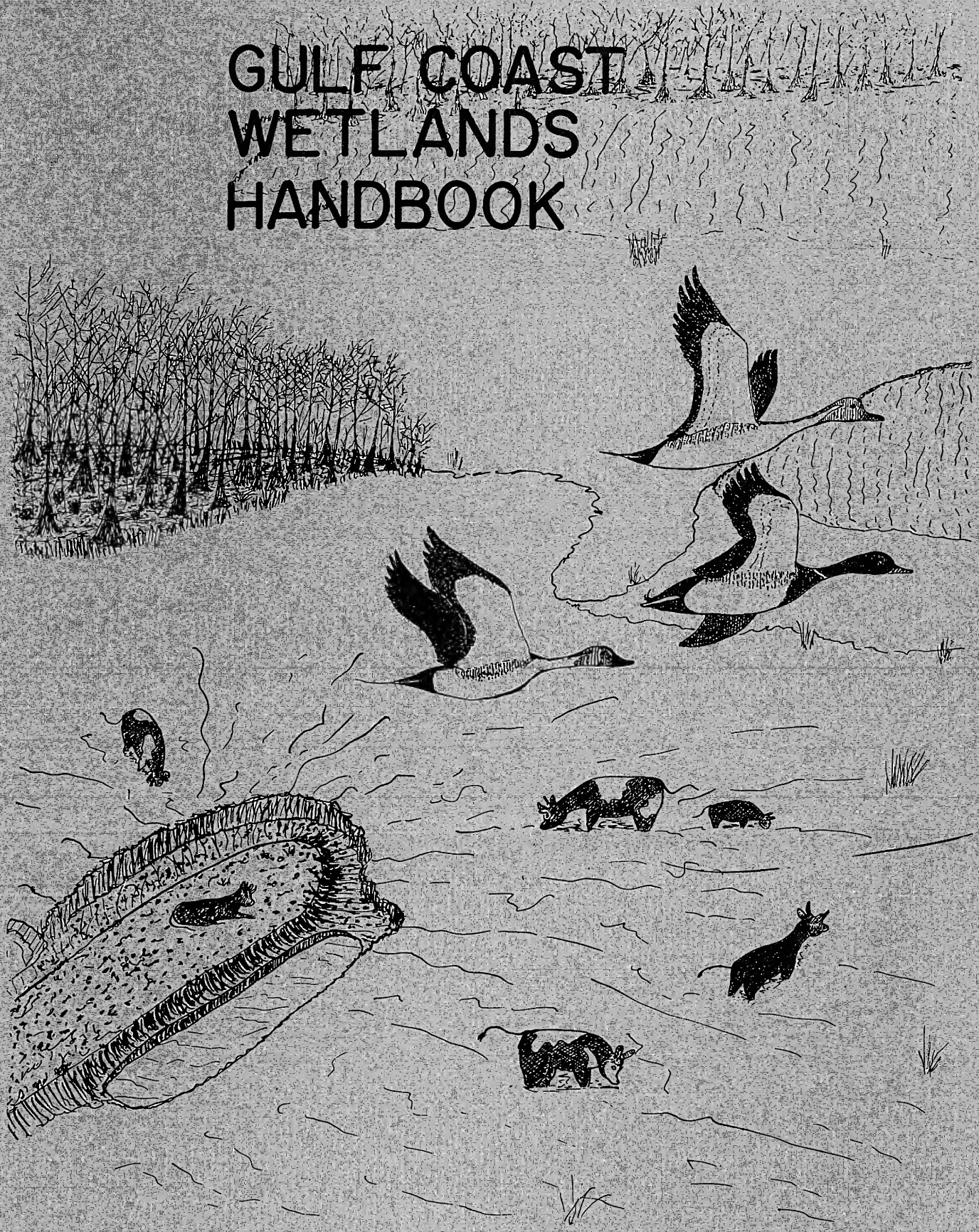
GULF COAST WETLANDS HANDBOOK



U. S. Department of Agriculture
SOIL CONSERVATION SERVICE
Alexandria, Louisiana

GULF COAST WETLANDS HANDBOOK

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FOREWORD

In recent years there has been a growing interest in the Nation's coastal zone. This interest stems from the "ecological awakening" of the late 1960's and early 1970's. This interest is not only confined to the general public, but to the State and Federal governments as well. This interest has brought forth two major pieces of legislation and a Soil Conservation Service Conservation Planning Memorandum that will deeply affect our work in the coastal zone.

The Federal Coastal Zone Management Act of 1972, Public Law 92-583, provides a plan for developing a management plan for the Nation's coastal zone. While not requiring the participation of the states, it does encourage them to formulate their own plan. This is done through a Federal incentive fund program. The State plans must conform with the Federal guidelines. The funding is in two phases; the first for developing a management plan and the second for administering this plan.

The second legislative act that must be recognized when working in the coastal zone is Section 404 of the Federal Water Pollution Control Act, Public Law 92-500. This law governs any action in the coastal zone which might alter wetlands or water quality. Water control structures, dredge and fill, ditching or any other type of action that might pollute or change the water regime of the marsh must be done by a permit issued by the U.S. Army Corps of Engineers. The application for these permits must be discussed with cooperators when working in this area. All construction will require these permits.

The memorandum that will have an effect on our work in the coastal zone is Conservation Planning Memorandum 15. This memorandum gives us guidance on work we can do and can't do in wetland areas. It is based on wetland types that are listed in the U.S. Fish and Wildlife Circular 39, "Wetlands of the United States".

Conservation Planning Memorandum 15 gives us permission to work in Wetland Types 1 and 2, and provide technical assistance, including changing the land use. This freedom of action is denied us for the rest of these Wetland Types, 3 to 20. SCS personnel cannot work with a landowner if he plans to permanently drain or alter these wetlands. However, we can work with a landowner if he plans to improve them for wildlife and range.

Our mission in coastal wetlands remains the same as it is in the uplands; to conserve and improve our basic natural resources. I urge you to keep this foremost in your mind when working in this area. However, we must also be mindful of the other laws that now cover our coastal wetlands.

Alton Mangum

Alton Mangum, State Conservationist

INTRODUCTION

At the widest point, the coastal marshes of Louisiana extend approximately 285 air miles from east to west. They vary in depth from 15 to 50 miles, north to south. This immense marsh area totals approximately 3.7 million acres, which means Louisiana has about 57 percent of the coastal marshes found along the Gulf and Atlantic coasts. These marshes are dotted with a myriad of lakes and ponds, and in many places the marsh looks more like islands in a lake than a contiguous entity. Conversely, there are also areas of solid marsh up to a mile square devoid of any water bodies.

These marshes are of immense economic value to the people of Louisiana, and all of the United States. A total of 6 billion dollars is produced annually in this area from commercial and recreational fishing, cattle, fur production, hunting and other recreational pursuits and mineral extraction. Any area producing this staggering wealth should receive the best of care and management.

These coastal marshes have been the site of a gargantuan battle between the sea and the land during the recent geological period. The land has encroached upon the seabed via silt and clay deposition of the Mississippi River and its distributaries. These deposited materials have given rise to the marshes as they are today. However, when this deposition ceases, the sea begins to erode the marsh and reclaim its former bed. At present, the deposition of clays and silts has been drastically reduced because the Mississippi River is dropping its sediment load off the continental shelf. As a result of this, and associated subsidence, we have been losing approximately 16.5 square miles of marsh annually for the past 25 to 30 years. Plans have been formulated to correct this loss, but such a program will take many years before restoration becomes a reality.

Caught in the middle of this battle between the sea and the land is the plant and animal life of the marsh. When the land is advancing, these plants and creatures that thrive best in fresh water become more abundant and are present over large areas. When the Gulf begins to encroach upon and erode the marsh the plant and animal life that favor saline conditions gain the upper hand.

To understand marsh ecology one must realize that the marsh is a dynamic system that is constantly changing. What was there 10 years ago may not be here today, and what is here today may not be here 5 years from now. As an example of this, one only needs to remember the dramatic change that took place in the marsh when Hurricane Audrey gave the marsh a good "salting". There was an immediate change in vegetation which persisted for several years, and animal life was destroyed in many areas. Today, the marsh has changed considerably since that time both in plant communities and animal life.

Man can manage the marsh to a certain degree. It can be improved for cattle, waterfowl, furbearers, and other forms of life. At this time, not all of the answers are known as to the management of these areas for estuarine larval forms that are marsh dependent in their early life stages. Shrimp, menhaden, bay anchovies, sea trout, blue crabs, and other estuarine and marine forms of life use the marsh as a nursery ground. How to maintain these forms in high numbers demands much research and study. However, it is felt that some day the answers to this problem will be found, and hopefully some future revision of this handbook will contain this information.

What is known of the marsh and its management will follow, and this data should be carefully studied and judiciously applied. It is to this end that this handbook is dedicated.

SECTION I

AGRONOMY

Pump-off For Crops and Pasture - Marsh soils are not suitable for crops or improved pasture unless a pump-off drainage system is installed. Levees, pumps, and associated structures must be designed to fit soil conditions and planned crops in order that the system functions properly. Subsidence potential, potential for increased acidity, pumping costs, and degree of salinity are major factors affecting pump-offs.

Most pump-off drainage systems now operating are in the marsh west of Vermilion Bay. They are on consolidated mineral soils at the higher elevations in the prairie to the marsh transition zone. Natural subsidence in this area in past years has changed prairie soils to freshwater marsh soils, therefore they are consolidated and firm. There are less hazards encountered when pump-off drainage systems are installed on consolidated mineral soils than on organic or unconsolidated mineral soils with semifluid layers.

The cropland-potential rating in Table I-Classification, Characteristics, and Interpretation of Marsh Soils, of the Soils section indicates the relative suitability of marsh soils for cropland and pasture after levees and drainage pumps have been installed.

Crops that utilize large amounts of nitrogen should be planted on coastal wetland soils. Crops in the grass family such as sugarcane, rice, and forage grasses are usually grown.

Excessive nitrogen may cause some crop production problems on pumped-off marsh soils during the first and second years. This can cause lodging and harvest losses on crops such as rice. Harvesting problems may be encountered with sugarcane. High grass yields without nitrogen can be sustained for fairly long periods on pumped-off marsh soils that have moderately thick organic layers.

Salinity will normally have little to no effect on crops grown on fresh-marsh soils. (See Table 1-Classification, Characteristics, and Interpretation of Marsh Soils (Page V-11) for further information.

Rice is very salt-tolerant during germination, but during the early seedling stage, it is very sensitive to salt. Grain production is affected much more than vegetative growth. Rice yields are reduced on moderate saline soils. Rice produces half of its normal grain yields when the electrical conductivity (EC_e) of the soil solution is 8 millimhos per centimeter (mmhos./cm) (5.2 parts per thousand [ppt]).

Sugar cane is quite tolerant to salt and can be grown on low saline class soils. Reduction in crop yields are experienced between 3.2 and 3.7 mmhos./cm EC_e (2.0-2.4 ppt).

Considering domestic crops, bermudagrass is very tolerant to salt. Yields are reduced only 10 percent at 13 mmhos./cm EC_e (8.3 ppt). Bermudagrass yields are reduced 25 percent at 16 mmhos./cm EC_e (10.2 ppt).

Dallisgrass and tall fescue yield reduction starts at about 6 mmhos./cm ECe (3.8 ppt) and reaches 25 percent at slightly over 10 mmhos./cm EC_e (6.4 ppt).

White clover tolerates no more than 2-4 mmhos./cm EC_e (1.3-2.6 ppt). White clover will grow under quite acid soil conditions on pumped-off marsh soils that are high in organic matter. Lime is usually not practical on these soils.1/

1/ Soil Conditions and Plant Growth. E. W. Russell, 9th Ed., 1961, Pg. 525, Wiley & Son Ltd., N. Y., New York.

SECTION II

BIOLOGY

This section will be broken into two subsections; marsh and swampland. This division is necessary because of the differences of the dominant vegetative types, the animal population, the salinity regime and the uses by man. Management techniques will also be entirely different because of the factors previously listed.

Marshes

Factors Affecting The Marsh -

As previously stated, the marsh is a dynamic entity that is constantly changing. It can vary in area, chemical, physical and biological features. These features are brought about by the following factors:

1. Sedimentation
2. Prolonged periods of inundation caused by wind tides or rain
3. Drought
4. Salt intrusion
5. Subsidence
6. Erosion

Each of these items may interact with one or more of the others, but each will be discussed separately.

Sedimentation aggrades, or builds marshes. This is now occurring rapidly at the mouth of the Atchafalaya River, and formerly at the mouth of the Mississippi River. However, most of the sediment of the Mississippi River is being deposited off the continental shelf in deep water where it will not be of any value to our marshes.

Sedimentation has also built the marsh area east and west of the Mississippi River. A westerly current of the Gulf carries the turbid waters of the Mississippi west. These waters deposit silts and clays along the coast. The cheniers of today are nothing more than wave-formed barrier beaches of the past which have been isolated from the sea by this type of deposition. Marsh-building sedimentation has contributed much to the marshland area in Vermilion and Cameron parishes.

As long as sedimentation is taking place, the marsh will remain static, or grow, depending on the amount of sediment delivered. The nutrients in the sediment are very important to plant growth. Vigorious plant growth contributes to the organic fraction of the soil and helps build the marsh. However, when sediment delivery stops, the marsh begins to deteriorate because of the combined forces of subsidence and erosion.

These newly formed lands are rapidly vegetated by pioneer plant species, which will eventually be succeeded by the vegetation best suited to the area.

Long periods of inundation by fresh water can change marsh vegetation and hence animal life. This flooding of a marsh can be caused by prolonged rains and subsequent drainage from the uplands and/or strong wind tides. These wind tides can do two things; they can hold fresh water on the marsh or flood the area with salt water. In either case, vegetation can be changed.

Invasion of freshwater vegetation has been noted in some former saline marshes as a result of freshwater flooding, such as during the wet years, '72, '73 and '74. Drought, too, can cause changes in a marsh, depending on the soil type. The first change may be the killing of vegetation by highly saline soil solutions. High soil salinity can be caused by evaporation of surface water, thus concentrating the salt on and in the soil profile. When this occurs, the remaining soil water is very highly charged with salts. High salinity solutions kill the plant roots and hence the plants. The second factor drought can cause is subsidence due to oxidation of the organic material in the profile. As long as organic material is covered by water it degrades very little. When exposed to the air, however, oxygen becomes available to the bacteria and they decompose the organic part of the soil. This, of course, occurs in soils which have high organic contents, such as mucks and peats.

Drought can improve the growing conditions of some of the submersed aquatics by firming up the pond bottoms (via oxidation of organic material) and by making plant nutrients available through chemical reactions with the air. This will also cause many annual plants to germinate and grow.

Salt intrusion is one problem of great concern to people working in the coastal zone today. Salt intrusion causes marsh deterioration in the following manner. First, the plants present are killed by the salt water. As these plants die and decompose, they lose their grip on the soil. Also, the salt water causes the organic soils to turn to a "soup", which is easily swept away by tidal action. This process causes holes in the vegetative cover which eventually develop into ponds. A striking example of this process is seen in the marsh north of Cameron, Louisiana, in the Grand Bayou area. This is not a rapid process, but one which becomes evident over the course of several years.

Salt intrusion is caused by hurricanes, subsidence, canals dug through the marsh and connected with tidal channels, and the cutting off of distributaries of river systems. Hurricanes are not on a regular or cyclic basis, but they cause severe damage when they occur.

Subsidence, the actual sinking or settling of the coastline, is taking place across the Gulf Coast, particularly east of the Atchafalaya Bay. Here, the marsh is sinking and salt water has easy access to the marsh by way of natural and manmade waterways. Both subsidence and the cutting off of the Mississippi distributaries are causing severe damage to the coast, especially to the Mississippi Delta.

Pipelines, drainage and navigational canals offer easy access to the marsh. They also allow salt water to enter the marsh and change the ecology. Many of the new canals, dug for oil exploration, are now being plugged to prevent salt intrusions. However, many of the older canals in the marsh are greatly accelerating marsh deterioration by permitting salt water into the area they transect.

Subsidence is a geological process that cannot be controlled, but where it is active, it must be taken into consideration in marsh planning. What is causing it has not been determined, but several theories have been proposed. Subsidence, of course, accelerates salt intrusion and erosion.

Erosion of the marsh is performed by wave action, and it is greatly hastened by storms. Wave action by boat traffic is a serious problem that erodes canal and bayou banks. This action can cause much damage by breaking through natural and manmade levees and allowing the watercourse to have easier access to the marsh. If this uncontrolled watercourse is carrying a charge of storm-borne salt water, it will cause severe damage to the fresh water marsh.

Marsh Zones -

The marshes of Louisiana are separated into two main divisons, the Deltaic Plain and the Chenier Plain. The Deltaic Plain lies east of Vermilion Bay and covers two-thirds of the coastal marsh. This area is actually a series of old deltas of the Mississippi River that has been highly modified by man, subsidence and wave action. Most of the marshes of this area are soft and offer very poor footing, hence, they are not normally used for grazing. Floating marshes occur in this area and appear in other areas where the old marsh has sunk and organic debris has been built up to the present level. These marshes are covered by a mat of plants which float on organic muck or peat. These marshes are very sensitive areas and only slight natural or manmade changes could greatly accelerate their deterioration.

The Deltaic Plain contains the active delta of the Mississippi River. Some authorities have isolated this area as an insular unit and described the attributes that separate it from the rest of the Deltaic Plain.

The Chenier Plain, lying west of Vermilion Bay, generally has more firm marshland and is used more extensively for cattle grazing. This area was formed by the dispositon of silts and clays swept westward from the Mississippi River by Gulf currents. It has not been affected by subsidence as much as the Deltaic Plain, but it has been reworked extensively by wave action. Subsidence is occurring here, but at a much slower rate.

The marshes of these two divisions have been further divided by Dr. Robert Chabreck 1/ into four units on the basis of vegetative types. These vegetative types are dependent upon the amount of salt in the soil and water which periodically cover them. The four divisions are fresh, intermediate, brackish, and saline marshes. The plants present in these types have varying tolerance to salt, and some are limited to one or two types. Others may appear in all four types (A list of the plants in each of the four divisions follows in the table titled "Plants of the Marsh, Their Values and Some Ecological Parameters," at the end of this section.)

To help the field office personnel distinguish these types, a brief description of each will follow. The map shown on page II-19 shows the distribution of the various types. These data may be consulted when details are desired.

Fresh Marsh - Fresh marshes are usually located adjacent to the uplands and generally cover the northernmost extent of the coastal marsh. Chabreck estimates that there are 1,222,000 acres of fresh marsh in Louisiana. The soils of these marshes are often high in organic matter.

Fresh marshes are dominated by such plants as maidencane (paille fine), bulltongue, spikesedge, alligatorweed and cattails. Other major components of fresh marsh are coastal waterhyssop, coontail, fragrant flatsedge, waterhyacinth, pennywort, duckweed, Eurasian milfoil, naiad, waterlilies, common reed, bladderwort, deerpea and giant cutgrass. The early successional stages of these marshes are excellent for waterfowl, nutria, and other wildlife. However, as they progress in their plant succession, their value decreases. Dense stands of alligatorweed, cattails, bulltongue or maidencane crowd out the better wildlife foods and make feeding difficult. Sawgrass was one of the dominant plants of this marsh type; but it has become very rare in the marsh, because

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1/ School of Forestry and Wildlife Management, LSU, Baton Rouge, La.

it cannot tolerate very much salt. Most of the sawgrass stands began to disappear in the late 1950's and early 1960's as the result of climatic conditions, drought, and prolonged flooding by rain, the feeding of nutria, and "saltings" brought on by hurricanes. Deer, alligator, crawfish, rabbit, nutria and duck concentrations generally are highest in the fresh marsh.

Fresh-marsh vegetation is very intolerant to salt, so this area is characterized by very low salinities (0-5 ppt 2/). After a flushing with salt water, most of the vegetation is killed, and it eventually becomes vegetated with plants that are somewhat salt tolerant.

Intermediate Marsh - This marsh is a little saltier than fresh marsh. It generally lies south of the fresh marsh, and is always found between fresh and brackish marsh. These marshes total 652,000 acres, making this type having the smallest acreage of all four vegetative types.

The salinity range of this marsh goes from .39 to 9.80 ppt with a mean 3.3 ppt, which is approximately 9 percent of Gulf-strength water.

The major plant species of the intermediate marsh are marshhay cordgrass, common reed and bulltongue. Also present in varying amounts are such plants as alligatorweed, coastal waterhyssop, coast cockspur, spikesedge, sprangletop, naiad, switchgrass, seashore paspalum, purple pluchea, saltmarsh, American and Olney bulrushes, giant and Gulf cordgrass, and deerpea.

The intermediate marsh is very productive of most forms of wildlife. In its earlier successional stages, it produces many of the choice wildlife foods. The soils of the intermediate marsh are generally high in organic matter and in many places offer very poor footing.

Brackish Marsh - This marsh is a buffer between the saline marsh or the Gulf itself, and the intermediate marsh. There are approximately 1,186,000 acres of this type in the coastal marshes of Louisiana. The soils of this marsh type are not as organic as the preceding two types, but they contain more organic material than the saline type. The brackish marsh may lie between the intermediate and saline, or may be directly adjacent to the Gulf.

The major plants of this type are marshhay cordgrass and seashore saltgrass. Other abundant plants of this association are dwarf spikesedge, needlegrass rush, seashore paspalum, widgeongrass, Olneys and saltmarsh bulrush, smooth cordgrass and deerpea.

This marsh, in its early successional stages, is excellent for muskrat and geese. Olney and saltmarsh bulrushes are the food plants

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2/ Sometimes this range is slightly higher. Chabreck (1972) showed a range of 6.66 to .06 ppt in his studies.

that are most attractive to these two animals. On occasion, ducks heavily utilize the brackish marsh. Alligator, crawfish, and nutria numbers begin to decrease in this type. Brackish marsh has a very high value to estuarine larval forms such as shrimp, crabs, menhaden, etc. Like the other types previously discussed, brackish marsh is more valuable to wildlife in its earlier successional stages.

The salinities found in this marsh type range from .42 to 28.08 ppt with a mean of 8 ppt, or approximately 23 percent of Gulf strength.

Saline Marsh - The saline marsh is adjacent to the Gulf and is usually subjected to lunar tides. The plants in this area have to be tolerant to high salinities, for this zone is frequently inundated by Gulf water.

The dominant plants of this marsh type are smooth and marshhay cordgrass, seashore saltgrass, and needlegrass rush. Other plants that are common in the saline marsh are saltmarsh bulrush, sea seepweed, batis, and glasswort. This marsh has the least plant diversity of any of the marshes in the coastal complex.

The salinity range of this marsh is the highest of all four types. Its range runs from .62 to 51.88 ppt with a mean of 16 ppt, or approximately 46 percent of Gulf strength.

This marsh has the least amount of wildlife, and many marsh creatures found in the other zones rarely enter this area. The species that do live here must be able to tolerate highly saline conditions. Estuarine larval forms frequent this marsh readily and use it as part of their nursery grounds.

The soils of the saline marsh have the lowest amount of organic matter found in any of the marsh types.

Wildlife In The Marsh

American Alligator - At present, the alligator is on the list of threatened wildlife. In Louisiana, however, this animal is abundant, especially in the coastal marshes. This reptile is most abundant in the fresh and intermediate marshes. Population numbers diminish as salinity levels increase.

The alligator responds favorably to protection and habitat management. Through protection, it has become so abundant in the coastal marshes of Cameron, Vermilion, and Calcasieu parishes that a special harvest season has been used to remove surplus animals.

Much information on the alligator's ecology has been collected at the Rockefeller Refuge in Cameron Parish. This research is continuing

and is now being oriented toward the commercial production of alligators. Also, information is being collected here which will serve as a base for the reestablishment of this species throughout its natural range.

Catfish - Wild catfish, mainly channels with some blues, are found in most of the bayous and rivers passing through the marsh. They have been found in bayous and marsh channels with salinities as high as 11.4 ppt.

Domesticated catfish have been raised experimentally in marsh ponds in water with a salinity range of .9 to 11.0 ppt. They have not, at this time, been successfully spawned in saline water. Eggs, fry and fingerlings will live successfully in saline water that does not exceed 8 ppt.

Besides salinity, the next biggest problem is the soils of the marsh. Levees are difficult to build and maintain on organic soils, because of low strength and subsidence. Catfish ponds must be built in marshes that have loamy or clayey soils.

Crawfish - Crawfish are found in fresh, intermediate and brackish marshes. They grow in marshes as long as salinities do not exceed 8 ppt. One raising crawfish should carry out practices (planting or burning) that will furnish tender vegetation as food for these animals.

Soils play an important part in crawfish culture. Crawfish can be managed where mineral soil is available for the construction of levees. Both construction and maintenance are problems with levees on organic soils. Generally the higher the pH of the soil, the better the crop of crawfish produced.

Whitetail Deer - The whitetail deer can and does live in marshes. These animals have developed exceptionally large hooves (for this species) that allow them to travel the soft marsh country. Deer are abundant near higher ground with brushy covers such as spoil piles from canals and natural bayou or river levees that have been vegetated by hackberry, tallowtree, eastern baccharis, bigleaf sumpweed, elderberry, polkberry, blackberry, willow and other species. They feed in the marsh and retreat to brushy cover to escape enemies or to find a shady place to "lay up" for the day. Deer favor fresh and intermediate marshes. Their numbers diminish in the brackish marsh, and they seldom venture into the saline marsh. Their food consists of tender marsh vegetation and browse from brushy spoil banks and natural levees of bayous and rivers.

Ducks - The coastal marshes of Louisiana are well-known for their abundance of ducks. These marshes carry up to 6 million winter residents and play an important role in providing feeding and resting areas for approximately 7 million more that migrate through this state while traveling to and from their wintering areas in the tropics.

These ducks favor fresh and intermediate marshes, but if the food supply and water conditions are suitable, the brackish marshes are also heavily used. In the early fall the saline marsh may be used by teal which feed on the seeds of Sesuvium.

The foods found in these marshes are the seeds of forbs, sedges, and grasses. The tubers of such plants as delta duckpotato, sago pondweed, and dwarf spikerush are also avidly taken along with submersed aquatics such as naiad, pondweeds, widgeongrass, and others. Leaves from plants such as waterhyssop and duckweeds are important in this diet.

The earlier successional stages of the fresh, intermediate and brackish marsh furnish the greatest abundance of duck foods.

Water depth is a critical factor in marsh use by ducks. If a marsh is dry, or if the water is too deep, dabbling ducks will not use a marsh. Fifteen inches is the maximum feeding depth ducks will tolerate.

Rice fields offer choice duck food, and they are used extensively when feeding conditions are suitable. Many ducks spend the day in the marsh, then fly to the rice fields to feed. Ducks also feed in the marsh if a choice food is available.

Estuarine Larval Forms - These are the young of such crustaceans and fish as the shrimp, blue crab, menhaden, croaker, spot, bay anchovy, and others that spawn in the Gulf of Mexico; these larval forms move from the Gulf into the marsh ponds and lakes to grow.

Each of these creatures has its own salinity tolerance and food preference. These creatures move into the marsh as larval forms, feed in this area and grow rapidly. At near or full maturity, they leave the marsh and return to the Gulf.

These creatures frequent ponds and lakes in the saline and brackish marsh and even go into the intermediate zone to fresher water. Estuarine larval forms are the basis of the multimillion dollar fishing industry of the Louisiana and Texas coasts.

Furbearers - Muskrat, nutria, mink, otter and raccoon are the important furbearers of the marsh. Louisiana leads the nation in the production of muskrat and nutria hides and meat. The muskrat is most abundant in the brackish marsh. Occasionally, when vegetation and water conditions are favorable, it may have good populations in the intermediate and saline marshes. The fresh marsh has the lowest muskrat populations. The nutria is most abundant in the fresh marsh, and its numbers drop drastically as salinities increase.

Little difference in productivity of the marsh types is noted for mink, otter, and raccoon. These animals are quite mobile and will cover several miles in their search for food.

Muskrats and nutria are vegetarians, whereas the mink and otter favor animal foods such as crustaceans, fish, amphibians, birds and animals. The raccoon is omnivorous, eating both vegetable and animal foods.

Geese - Snow 3/ and white-fronted geese are the most numerous species of geese now found in the Louisiana marsh. Shortstopping at Federal and State waterfowl refuges further north has sharply reduced the number of Canada geese wintering in Louisiana, and as a result, the Canada goose population is down to around 5,000 and appears to be static.

Snows and white-fronts will take rice, when available, but snow geese primarily eat grasses and the roots of Olney and saltmarsh bulrushes and the leaves of freshly burned marshhay cordgrass. The brackish marsh is the favorite zone for geese, since Olney and saltmarsh bulrushes are common plants there. In its early successional stages this marsh type may have large stands of the Olney and saltmarsh bulrushes; geese feed readily upon them. A burned-over marsh that is revegetating with new, tender grasses, such as duck millet, new leaves of marshhay cordgrass and others, is also a favorite feeding site for these geese. After heavy goose use, the marsh may be completely denuded of all vegetation, and it will look as if the area had been spaded with a shovel. Such denuded areas are called "eatouts".

Ryegrass fields, planted for pasture, will frequently get extensive use by flocks of geese. This evokes the wrath of the landowner, since geese are capable of completely destroying such a pasture.

Nongame Birds - The coastal marshes teem with both resident and migratory nongame birds. One hundred fifty-three species of birds were recorded in the 1953 Christmas bird count in the Sabine-Cameron area. People come from many miles away to see such a great and diverse assemblage of birds. Many are resident species, being hatched and raised in the marsh, but many more are migrants either passing through or staying as winter residents.

The coastal marshes acquire such a diversity of nongame birds because of their geographic location at the end of the Mississippi flyway. The marshes are a stopoff for many species before the flight across the Gulf or when returning during spring migration. Also, marshes offer a large number of diverse habitats that many different types of birds can use.

3/ Both Blue and Snow goose are now considered as a single species with two color phases.

Many species of water birds, both resident and migrants, abound in the area. Many terrestrial forms pass through here enroute to, and upon returning from, Central and South America. The marsh is truly a "birder's paradise."

Rabbits - Both the swamp and cottontail are found in the coastal marsh, but the cottontails' occurrence is much more limited than the former. The swamp rabbit lives in all sections of the marsh, but is least abundant in the saline type. Although these rabbits swim well, they do not remain in an area where the water gets too deep for their comfort.

Roads, canal spoil banks, oil well locations, and natural levees offer retreats for the swamp rabbit when the water gets too high. These rabbits live on the marsh vegetation and in some areas achieve very high populations. Little has been done in the way of research on these creatures, but they should not be too difficult to manage. It is believed that several of the practices that will be discussed later will benefit them.

Management Techniques To Be Used In The Marsh

Weirs - Weirs are low level dams with a fixed crest, placed in marsh watercourses approximately 6 inches below the average level of the surrounding marsh. These structures do several things. They stabilize water levels in the marsh and reduce the turbidity levels of this water. Stable water levels help grow better crops of wildlife and cattle foods. Weirs prevent the marsh from drying out during prolonged droughts or when strong north winds blow for prolonged periods. Salinities are also stabalized somewhat by such structures. They maintain water in the marsh which can be used by feeding waterfowl and furbearers and by many for boat travel.

Weirs are most useful in brackish and intermediate marshes. If used in the fresh marsh where complete water control is needed, they should be modified to have a variable crest. Weirs may have limited value in the saline marsh.

To prevent damage from boat waves, such structures should be set back several hundred feet from the mouth of the bayou or drain. The "wings" of the weir should be extended into the marsh far enough to prevent the water from cutting around the structure. Piling, or materials used, should be approximately three times as long as the depth of the water. On streams with a large watershed, the six-inch below-the-average marsh level may have to be lowered to accommodate the added water.

Consult your area engineer for the design of these structures, or see Engineering Field Manual, Louisiana Supplement, structures, fig. 56-32.

Prescribed Burning - Prescribed burns (see Technical Guide, Section IV, Prescribed Burning-338) do several things in a marsh that benefit wildlife. The most important of these is the setting back of the ecological succession to a plant stage which contains more food-producing plants. This is best illustrated by a marshhay cordgrass marsh which, when dominant, produces very little wildlife food. Here a burn will remove the accumulated rough and allow desirable secondary plants such as Olney bulrush to grow. Under controlled water conditions, a burn will encourage many desirable duck foods, such as the duckmillets (Echinochloa spp.), sprangletop, coastal waterhyssop and saltmarsh bulrush. They will remain in the vegetative community until the marshhay cordgrass regrows and crowds them out. This usually takes three to four years.

A burn increases the nutrients necessary for plant growth. (These nutrients are found in the ashes and slightly increases the pH of the soil.) The blackened soils warm up more quickly and enhance the growth of plants.

There are two types of prescribed burns, a wet burn and a root burn. A wet burn is one where standing water is on the ground and prevents any root damage to the plant community. A root burn is one where the soil is dry enough to cause damage to the root system of the marshhay cordgrass. Care must be taken to have the proper level of soil moisture, or the fire could damage the deeper root system of Olney and saltmarsh bulrush. A biologist should be consulted on this type of burn.

Fall and winter burns favor Olney bulrush, as it grows better in the fall, winter, and early spring. Saltmarsh bulrush grows best in late spring and is a fast grower.

When burning for geese, a wet cover burn is used. Burn two or three weeks (late Sept. - early October) before they arrive. Spread burns out over the fall and winter months to keep young, tender, green vegetation coming on. As the vegetation gets taller, geese abandon such fields. Burns should be made about a month apart.

Level Ditches - Level ditches and their counterparts, blasted potholes, can be used to add surface water to large areas of solid stands of vegetation. These openings should never be placed in a way in which they will drain an area. Level ditches can be dug by a dragline or blasted with dynamite. (See the Standards and Specifications, Wildlife Wetland Habitat Management-644, in Section

IV, Technical Guide, and Engineering Technical Release 1 for details.) Blasting should be done under the advice of someone who is fully trained in the use of dynamite.

Large, unbroken stands of vegetation are not greatly used by wildlife, especially ducks. Opening up these solid stands of vegetation benefits wildlife in several ways. It will offer drinking water for all animals (depending on the salinity); it will offer roosting sites for waterfowl; it will furnish food in the forms of submersed and emergent aquatics, insects, crustaceans, etc. Spoils, if dug by dragline, will offer denning sites for nutria and muskrats and nesting area for birds.

Level ditches or potholes can be used in any of the marsh types. In the saline and brackish areas, widgeongrass may invade these ponds. It can also be introduced. Some form of submersed aquatics will invade these ditches, and many will be used as food by wildlife. If turbidity prevents the establishment of submersed aquatics, fish may be the problem. Ponds may need a treatment with rotenone to eradicate them.

Leveed Impoundments - Leveed impoundments can be used in all of the marsh types where suitable soils for their construction are present. They are most valuable in producing food and roosting sites for marsh wildlife. Almost every form of wildlife in the marsh will utilize these impoundments. However, their greatest value would be in the brackish and saline marshes. In these areas, such ponds can produce widgeongrass, a choice food of many ducks and, to a lesser extent, of many geese. Sometimes dwarf spikerush and sago pondweed will accompany the widgeongrass in these ponds. If present, they will widen the choice of food available, since they, too, are excellent duck foods.

Engineering assistance should be requested when one of these impoundments is planned, because several factors must be considered carefully before specifications are drawn up. Water can be pumped economically into these impoundments with a low-lift pump driven by a tractor-power takeoff or a portable motor. As soon as it is completed, the levee should be vegetated by sprigging with marshhay cordgrass or by seeding with bermudagrass seed.

An 18-24-inch water depth seems to be the best depth to insure the maximum production of widgeongrass. A constant water level should be maintained for the best results. This plant will grow in salinity ranges from 0 to 77 ppt, but it reaches its maximum production on the Gulf coast with a 2 to 18 ppt range.

Widgeongrass has two growth periods, one in the fall and one in the spring. The temperature range for best growth is 68° to 86° F. (20°-30° C.)

Turbidity is a problem that sometimes occurs in widgeongrass ponds. It is usually caused by fish or by wind activity.

Fish can be eradicated by treating the pond with rotenone or by drying out the pond during the summer months. Wind is a more difficult problem, but it can be lessened somewhat by leaving clumps of vegetation - mainly marshhay cordgrass - scattered around the pond. Another aid is to make the pond rectangular and orientate the long axis at right angles to the prevailing winds. The practice of leaving clumps of marshhay cordgrass also provides cover for ducks, making the pond more attractive to them.

Drying out a pond during the summer, or at least every third year, oxidates the organic debris on the bottom and consequently firms it up. This reduces turbidity from waves and gives a firm substrate for widgeongrass plants to grow on. As mentioned before, this also removes any fish populations that might be present.

Algae, particularly Cladophora, sometimes invades these ponds and reduces production of widgeongrass by shading. This problem can be reduced by the introduction of young mullet which feed on this plant and control it. The young mullet can be removed by the summer drawdown.

Widgeongrass seed germination is retarded by high concentrations of salt in the soil. This problem can be reduced by pumping in fresh water and then removing it a few days prior to the summer drawdown. This gives better germination of the widgeongrass seeds.

Salinity should be checked frequently so as to maintain the proper range. If a pond becomes too fresh, weed problems can occur. Tropical cattail, Typha domingensis, frequently invades such areas during times when salinities are 5 ppt or less. It can be removed by increasing the salinity. When strong south winds push Gulf-strength waters into the bayous, the pump can be started and saltier water added.

Widgeongrass ponds sometimes suffer from eatout by high duck concentrations. A new stand can be encouraged by dropping the water level to 2 to 4 inches and letting a new crop germinate. After germination has taken place, the water level should be raised slowly to the 24-inch depth.

Soils

Marsh soils determine what can and cannot be done in a marsh. As a general rule, the organic soils, such as Maurepas and Lafitte, severely limit the management of marshes. On the other hand, Palm

Beach and Harris soils permit a wide variety of management techniques. (See the Soils section of this handbook for details on the limitation of marsh soils.)

Salinity

Salinity can produce favorable or unfavorable conditions, depending on what one is trying to accomplish in a marsh. Salinities are calculated in parts per thousand, ppt; parts per million, ppm; millimhos per cm, ECx103; grams per gallon, gr/gal; and percent sea strength. A conversion table from one mode of expression to another is found on page II-20. At the present, most salinities are being expressed in parts per thousand as opposed to the other units.

Each coastal marsh field office should have a salinity determination kit, including a thermometer and Vogel unimometer for reading salinities. Instructions for its use were furnished with these kits. This kit, while not as accurate as some more recent electronic devices, is accurate enough for field use.

The salinity of a marsh will determine the wildlife present. Manipulations of salinity can change plant communities. The plant communities, of course, govern the wildlife present. The preferred marsh type for various forms of wildlife is discussed under "Wildlife in the Marsh", and can be referred to when determining animals desired in comparison to salinity regime. Also, a table found in the Appendix gives a list of plants important to wildlife and their salinity range.

One point should be observed; the introduction of large volumes of salt water into fresh, intermediate, or brackish marshes must be avoided at all times.

Marsh Grazing

Grazing and marsh wildlife can be compatible provided proper range use is attained. Overgrazing severely limits wildlife use of a marsh, except for the common snipe. Landowners wanting wildlife crops on their marsh should closely adhere to their soil and water conservation plans. (For details on grazing see the Range section of this handbook.)

Swampland

Swamplands in Louisiana either fringe the northern section of the coastal marsh or extend into the Atchafalaya Basin. The soil units upon which these wooded areas are found will determine the types of management which can be undertaken. Some are so soft

that little can be accomplished; others are firm and offer a wide range of alternates. Since these soils are so influential to management, this analysis of swampland will be discussed by soil areas. All of these swamps are associated only with fresh water.

Barbary - These soils are dominated by such trees as baldcypress, water tupelo, Drummond red maple and black willow. The understory is open with only a few scattered shrubs or a floating mat of waterhyacinth or duckweed. These areas are usually flooded with varying depths of water most of the year.

Because of severe structural limitations, little can be done in these areas for wildlife. The wildlife found in such areas is limited to squirrels, wood ducks, alligators, wading birds and other nongame species. Deer and swamp rabbits use these areas when they are dry or not flooded too deeply. Not much food is available within these areas. Squirrels find both dens and food in such swamps, whereas the wood duck will only find dens. Migratory waterfowl may use such areas as roosting sites. Raccoon, mink, and otter are the furbearers that are associated with these areas.

Fausse - Because of its firmer substrata, the Fausse soils offer the best opportunity for management. However, they still have limitations due to flooding.

The trees dominating these soils are green and pumpkin ash, baldcypress, water hickory, water tupelo and others. The understory can be open, dense with reproduction of the dominant species, or invaded by such shrub species as buttonbush, snowbell or swamp-privet. The density of the understory will be dependent upon past management of the present stand.

Frequently within the Fausse soil area are inclusions of other soils, such as Sharkey, which will support stands of trees producing more desirable wildlife foods. Nuttall and overcup oak are frequently found on these "better-drained" sites.

Wildlife that may be found within the boundaries of this soil area are deer, turkey, squirrel, rabbit, wood and migratory ducks, crawfish, wading birds and alligators.

The presence or absence of these birds or animals would depend on flooding, food- and den-producing trees, and the density of the understory.

Wood ducks are permanent residents in areas of Fausse soils. They nest, rear their young and feed in these areas. Migrant ducks also use these areas for roosting sites. Mallards are most likely encountered. They will utilize any acorns produced in this area.

The best management for ducks in this area would be the encouragement of oaks wherever they appear. Ash can also be favored, since it is also taken by wood ducks as food. Trees having dens suitable for nesting should also be spared during harvest operations. Timber harvest will benefit ducks by encouraging forbs and grasses to grow when the canopy of the forest is broken or removed.

Areas where food is present can be artifically flooded during the duck season by leveeing the area and pumping water into the area. These impounded areas, however, are short-lived in usefulness because of natural flooding. Flooding not only increases the water depth beyond the reach of feed ducks; it can also wash away levees and water-control structures. The growth of domestic crops is limited to Japanese millet, which can tolerate flooding.

The key to management for deer, rabbit, squirrel and turkey is in good timber management. Sparing oaks, water tupelo, and cypress of good form and mast-producing potential during a selective cut would do much for these game animals and birds. Small areas of clearcuts would also be beneficial if they were economically feasible. Rabbits and deer would benefit from the browse crop produced (stump sprouts, forbs, vines and grasses). Squirrels and turkeys would benefit from the seeds and fruits afforded by shrubs, vines, forbs, and grasses.

These soils produce excellent crops of wild crawfish. A large part of the wild harvest comes from these soils in the Atchafayala Basin. Again because of the restrictions placed on levees by flooding, only limited management can be undertaken on these soils.

These soils also support good crops of such furbearers as raccoon, mink and otter. Beneficial management practices for these animals in this wetland have not been determined.

Maurepas - These soil areas support a sparce stand of baldcypress with encroaching marsh grasses. Giant-cutgrass is quite common on this soil. Since these soils are mainly organic, full of logs and stumps, and generally flooded, little can be done in the way of wildlife management.

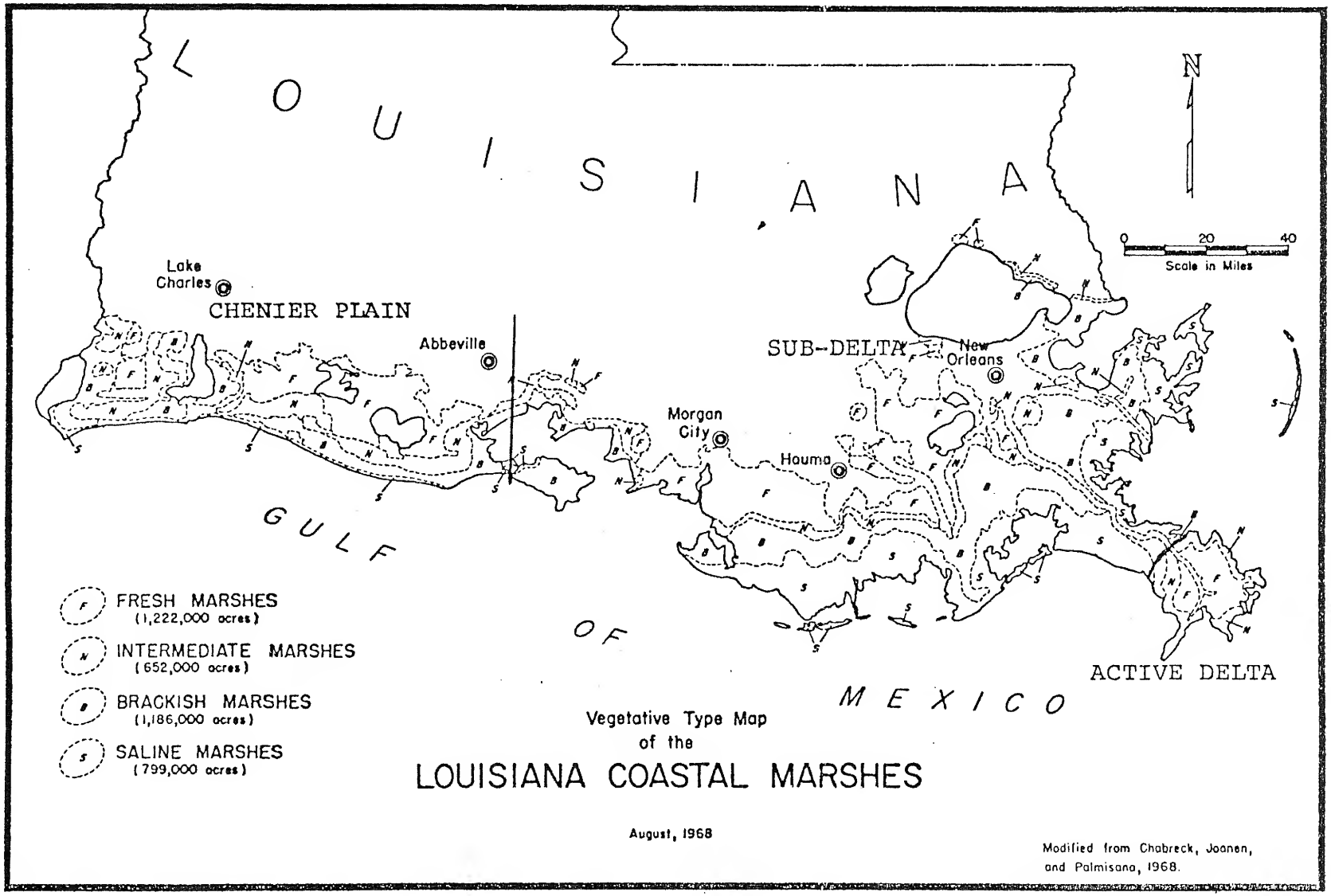
The animals associated with these soils are ducks (wood ducks and migrants), furbearers (nutria, mink, otter and raccoon), alligators, and wading and other nongame birds. They are good as wildlife habitat, and little can be done to improve them.

NOMENCLATURE OF PLANTS MENTIONED 1/

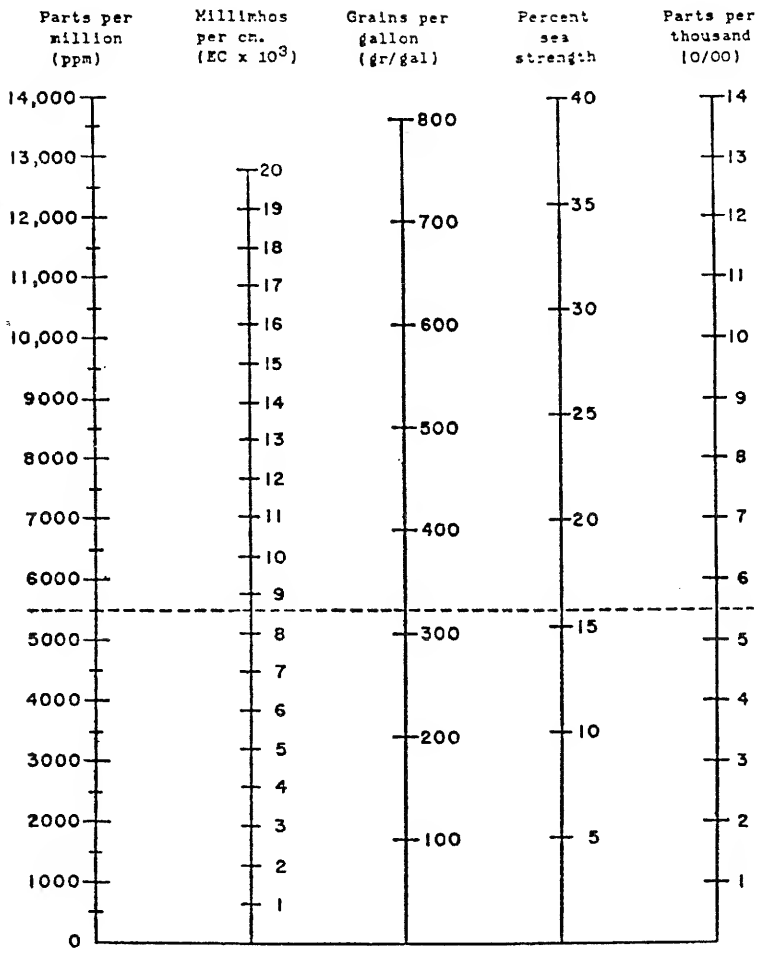
Alligatorweed	Alternanthera philoxerides
American Bulrush	Scripus americanus
Baldcypress	Taxodium distichum
Big cordgrass	Spartina cynosuroides
Black willow	Salix nigra
Bladderwort	Utricularia sp.
Bulltongue	Sagittaria lancifolia
Buttonbush	Cephalanthus occidentalis
Cattail	Typha latifolia
Coast cockspur (wild millet)	Echinochloa walteri
Coastal waterhyssop	Bacopa monnieri
Common reed (roseau)	Phragmites communis
Delta arrowhead	Sagittaria platyphylla
Drummond red maple	Acer rubrum var drummondii
Duckweed	Lemna sp.
Dwarf spikesedge	Eleocharis parvula
Eurasian milfoil	Myriophyllum spicatum
Fennelleaf pondweed (sago)	Potamogeton pectinatus
Fragrant flatsedge	Cyperus odoratus
Giant cutgrass	Zizaniopsis miliacea
Glasswort	Salicornia bigelovi and virginica
Green ash	Fraxinus pennsylvanica
Gulf cordgrass	Spartina spartinae
Hairypod cowpea	Vigna luteola
Hornwort (coontail)	Ceratophyllum demersum
Japanese millet	Echinochloa crusgalli var. frumentacea
Maidencane (paille fine)	Panicum hemitomon
Marshhay cordgrass (wiregrass)	Spartina patens
Southern naiad	Naias guadalupensis
Needlegrass rush	Juncus roemerianus
Nuttall oak	Quercus nuttallii
Olney bulrush (three-square)	Scirpus olneyi
Overcup oak	Quercus lyrata
Pennywort	Hydrocotyle sp.
Pondweed	Potamogeton sp.
Pumpkin ash	Fraxinus profunda
Purple pluchea	Pluchea purpurascens
Purslane sesuvium	Sesuvium portulacastrum
Saltmarsh bulrush (coco)	Scirpus robustus
Saltwort	Batis maritima
Sawgrass	Cladium jamaicense
Seashore paspalum	Paspalum vaginatum
Seashore saltgrass	Distichlis spicata
Sea seepweed (sea-blite)	Suaeda linearis
Smooth cordgrass	Spartina alterniflora

1/ The common names are taken from Standardized Plant Names.

Snowbell	Styrax americana
Spikesedge	Eleocharis sp.
Sprangletop	Leptochloa fascicularis
Swampprivet	Forestiera acuminata
Switchgrass	Panicum virgatum
Water hickory	Carya aquatica
Waterhyacinth	Eichhornia crassipes
Waterlilies	Nymphaea sp.
Widgeongrass	Ruppia maritima
Tropical cattail	Typha domingensis


LOUISIANA
N
0 20 40
Scale in Miles
Lake Charles
CHENIER PLAIN
Abbeville
SUB-DELTA
New Orleans
Morgan City
Houma
GULF OF MEXICO
ACTIVE DELTA
FRESH MARSHES (1,222,000 acres)
INTERMEDIATE MARSHES (652,000 acres)
BRACKISH MARSHES (1,186,000 acres)
SALINE MARSHES (799,000 acres)
Vegetative Type Map of the
LOUISIANA COASTAL MARSHES
August, 1968
Modified from Chabreck, Joanen, and Palmisano, 1968.

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE



CONVERSION OF SEVERAL METHODS OF EXPRESSING SALINITY

With a straight-edge, read across the page. For example, 5,500 ppm is 8.8 millimhos per cm, 320 grains per gallon, 16 percent sea-strength or 5.5 o/oo

PLANTS OF THE MARSH, THEIR VALUES AND SOME ECOLOGICAL PARAMETERS (1)

Scientific Name	Common Name (2)	% Vegetation Composition of marsh types (3)				Food Value to Wildlife (5)				pH Range (3)	Salinity Range (3) PPT
		Saline	Brackish	Intermediate	Fresh	Ducks	Geese	Furbearers (6)	Crawfish		
Acnida alabamensis	Gulf Coast waterhemp		.10	.30	.02	Fair				4.10-7.50	7.29± 5.22(4)
Alternanthera philoxeroides	Alligatorweed			2.47	5.34	Poor	Poor	Good	Excel	4.80-7.70	2.73± 4.94
Ammannia coccinea	Purple ammannia								Poor	4.00-5.90	5.72± 3.55
Aster sp.	Aster		.08	.44	.13					4.50-7.50	9.69± 6.24
Avicennia nitida	Blackmangrove	.60								5.70-7.70	25.72±13.65
Azolla caroliniana	Mosquitofern				.13						
Baccharis halimifolia	Eastern baccharis		.10	.56	.02					4.00-7.50	7.46± 5.57
Bacopa caroliniana	Carolina waterhyssop			.28	.34	Fair			Good	5.10-5.90	2.83± 4.41
Bacopa monnieri	Coastal waterhyssop		.92	4.75	1.44	Good			Excel	4.00-7.50	3.93± 2.27
Bacopa rotundifolia	Disk waterhyssop		.11	.32		Fair			Fair		
Batis maritima	Maritime saltwort	4.41								4.00-7.90	23.60± 9.97
Bidens laevis	Smooth beggarticks				.08	Poor				4.70-5.40	0.81± 0.61
Borrichia frutescens	Bushy sea-oxeye	.67	.11							6.10-7.50	12.24± 8.52
Brasenia schreberi	Schreber watershield					Good					
Cabomba caroliniana	Carolina fanwort				.71	Poor			Fair		
Carex sp.	Sedge				.02		Fair		Fair	5.00-7.50	0.09± 0.00
Centella asiatica	Spadeleaf			.16	.12					4.50-5.30	2.18± 1.37
Cephalanthus occidentalis	Common buttonbush				.21	Fair				4.90-6.20	0.72± 1.00
Ceratophyllum demersum	Common hornwort					Fair			Fair		
Chara vulgaris	Stonewort					Fair	Poor			5.20-6.20	1.85± 2.00
Cladium jamaicense	Jamaica sawgrass				.84	Good	Fair			4.50-7.50	3.96± 2.58
Colocasia antiquorum	Elephantears				.39					5.40-6.40	0.64± 0.39
Cuscuta indecora	Showy dodder		.02				Poor			4.50-6.10	6.23± 2.86
Cyperus compressus	Poorland flatsedge				.02	Fair			Fair	5.20-7.50	0.16± 0.05
Cyperus odoratus	Fragrant flatsedge		.84	2.18	1.56	Fair			Fair	3.80-7.50	3.20± 2.80
Daubentonia texana	Rattlebox			.04	.17					4.30-8.00	2.61± 4.32
Decodon verticillatus	Waterwillow				.51					4.30-5.30	1.23± 1.41
Dichromena colorata	Starrush whitetop-sedge				.03					5.20-5.80	2.39± 2.17
Distichlis spicata	Seashore saltgrass	14.27	13.32	.36	.13	Good	Good	Good		4.10-8.00	13.32± 6.70

Scientific Name	Common Name (2)	Vegetation Composition of marsh types (3)				Food Value to Wildlife (5)				pH Range (3)	PPT Salinity Range (3)
		Saline	Brackish	Intermediate	Fresh	Ducks	Geese	Furbearers (6)	Crawfish		
Dryopteris thelypteris var. haliana	Marshfern				.44					4.30-5.60	0.67± 0.43
Echinochloa colonum	Junglerice					Excel			Good		
Echinochloa crusgalli	Barnyardgrass					Excel			Good		
Echinochloa crus-pavonis	Gulf cockspur					Excel			Good		
Echinochloa polystachya	Wildmillet					Excel			Good		
Echinochloa walteri	Coast cockspur		.36	2.72	.77	Excel			Good	3.80-7.40	2.89± 2.43
Eichhornia crassipes	Common water-hyacinth				1.43				Poor	4.50-6.90	0.37± 0.10
Eleocharis parvula	Dwarf spikesedge		2.46	.49	.54	Good	Good	Fair		3.70-6.70	6.69± 3.84
Eleocharis quadrangulata	Squarestem spike-sedge					Fair	Fair	Good			
Eleocharis sp.	Spikesedge		.82	3.28	10.74	Fair	Fair			4.00-8.00	3.88± 4.29
Eupatorium capillifolium	Dogfennel eupatorium				.05					4.30-5.80	1.26± 1.37
Fimbristylis castanea	Corm fimbry	.04	.11	.12		Fair				5.40-7.80	9.85± 7.05
Gerardia maritima	Seaside gerardia	.01	.08							5.20-6.90	7.01± 3.00
Heliotropium curassavicum	Salt heliotrope		.02			Poor					
Hibiscus lasiocarpos	Woolly rosemallow			.10	.05					4.30-7.50	1.38± 1.24
Hydrocotyle sp.	Pennywort					Poor				4.30-6.90	1.22± 1.16
Hydrocotyle bonariensis	Largeleaf pennywort				.02	Poor					
Hydrocotyle ranunculoides	Floating pennywort				.11	Poor					
Hydrocotyle umbellata	Umbrella pennywort				1.93	Poor					
Hymenocallis occidentalis	Island hymenocallis									5.40-6.80	3.69± 4.91
Hypericum virginicum	Virginia St. Johns-wort				.07					5.00-5.90	0.71± 1.12
Ipomoea sagittata	Marsh morningglory		.13	.84	.19					3.80-7.50	4.91± 4.71
Iva ciliata	Seacoast sumpweed									5.60-7.50	1.61± 1.51
Iva frutescens	Bigleaf sumpweed	.03	.10							4.00-7.20	10.29± 8.02
Juncus effusus	Common rush				.11					5.30-5.90	0.23± 0.01
Juncus roemerianus	Needlegrass rush	10.10	3.93	.72	.60					4.30-7.10	13.89± 8.27
Ludwigia peploides var.glabrescens	Floating waterprimrose				.24				Excel	5.00-5.70	0.38± 0.35

Scientific Name	Common Name (2)	Vegetative Composition of marsh types (3)				Food Value to Wildlife (5)				pH Range (3)	Salinity Range (3) PPT
		Saline	Brackish	Intermediate	Fresh	Ducks	Geese	Furbearers (6)	Crawfish		
Kosteletzkya virginica	Virginia saltmarsh mallow		.02	.18	.07					4.40-7.50	2.55± 1.02
Lemna minor	Common duckweed		.02	.16	2.31	Good			Fair	4.10-7.10	1.13± 0.76
Leptochloa fascicularis	Bearded sprangletop		.32	2.17	.49	Good	Good		Good	4.60-7.50	5.05± 3.17
Leptochloa filiformis	Red sprangletop			.04		Good	Good		Good		
Leptochloa uninervia	Mexican sprangletop					Good			Good		
Limnobium spongia	Common frogbite				.16	Poor				5.10-5.90	0.45± 0.39
Lippia nodiflora	Lippia				.06					4.30-5.90	1.88± 0.76
Lycium carolinianum	Carolina wolfberry	.07									
Lythrum lineare	Wand lythrum	.01	.16	.18	.07					3.70-6.50	5.45± 4.02
Myrica cerifera	Southern waxmyrtle				.16	Poor				4.30-5.60	1.29± 1.13
Myriophyllum spicatum	Eurasian watermilfoil		.15	.44	1.56	Good			Fair		
Myriophyllum heterophyllum	Changeleaf parrotsfeather				.19	Poor			Fair		
Najas guadalupensis	Southern naiad			1.03	1.07	Excel	Good		Fair	5.00-6.20	0.64± 0.41
Nelumbo lutea	Lotus				.54	Good					
Nymphaea mexicana	Yellow waterlily					Excel					
Nymphaea odorata	American waterlily				1.15	Good				5.00-5.40	0.36± 0.23
Osmunda regalis	Royalfern			.16	.43					4.30-5.20	1.45± 1.31
Panicum dichotomiflorum	Fall panicum					Good			Good		
Panicum hemitomon	Maidencane			.76	25.62			Good	Fair	4.30-6.30	1.02± 1.13
Panicum repens	Torpedograss			.92	.24		Good	Good	Fair	5.50-8.00	1.73± 1.22
Panicum virgatum	Switchgrass		.14	2.51	.45	Good				4.50-7.50	3.14± 3.68
Paspalum dissectum	Mudbank paspalum			.40	.42	Fair			Good		
Paspalum distichum	Knotgrass					Fair			Good		
Paspalum lividum	Longtom					Fair			Good		
Paspalum vaginatum	Seashore paspalum		1.38	4.46	.35	Good	Fair		Fair	5.10-6.70	3.27± 3.47
Phragmites communis	Common reed		6.63	2.54				Fair		3.70-8.00	3.33± 3.96
Pluchea camphorata	Camphor pluchea	..87	2.26	.36						3.80-8.00	6.34± 5.53
Polygonum coccineum	Bigroot smartweed					Excel			Excel		
Polygonum densiflorum	Stout smartweed					Excel			Excel		
Polygonum hydropiperoides	Swamp smartweed					Excel			Excel		
Polygonum lapathifolium	Curlytop smartweed					Excel			Excel		

Scientific Name	Common Name (2)	Vegetative Composition of marsh types (3)				Food Value To Wildlife (5)				pH Range (3)	Salinity Range (3) PPT
		Saline	Brackish	Intermediate	Fresh	Ducks	Geese	Furbearers (6)	Crawfish		
Polygonum punctatum	Dotted smartweed					Excel			Excel		
Polygonum sp.	Smartweed				.56	Excel			Excel	4.00-5.60	2.12± 2.07
Pontederia cordata	Pickerelweed				.07	Poor		Poor			
Potamogeton diversifolius	Waterthread pondweed					Good			Fair		
Potamogeton nodosus	Longleaf pondweed					Good			Fair		
Potamogeton pectinatus	Fennelleaf pondweed					Excel			Fair		
Potamogeton pusillus	Baby pondweed			.24	.62	Good			Fair		
Rhynchospora corniculata	Horned beakrush					Good				5.10-5.60	0.28± 0.06
Ruppia maritima	Widgeongrass		3.84	.64		Excel	Good			3.70-6.40	8.95± 6.39
Sagittaria falcata	Bulltongue			6.47	15.15					4.30-6.30	1.70± 1.59
Sagittaria platyphylla	Delta arrowhead					Excel	Good	Good			
Salicornia bigelovii	Bigelow glasswort	.13								6.60-8.50	14.84±16.79
Salicornia virginica	Woody glasswort	.63									
Salix nigra	Black willow				.06					4.70-7.50	0.93± 0.05
Saururus cernuus	Lizardstail				.16					5.10-6.40	0.32± 0.05
Scirpus americanus	American bulrush			1.27	.13	Good	Good	Good		6.70-7.80	1.50± 1.15
Scirpus californicus	California bulrush			1.83	.42	Good	Fair	Fair		4.10-6.20	1.63± 1.22
Scirpus olneyi	Olney bulrush		4.97	3.26	.45	Excel	Excel	Excel		3.70-6.90	7.23± 5.10
Scirpus robustus	Saltmarsh bulrush	.66	1.76	.68		Excel	Excel	Excel		4.00-6.90	8.90± 5.30
Scirpus validus	Softstem bulrush		.08			Good		Fair		5.30-5.80	1.12± 0.67
Sacciolepis striata	American cupscale					Fair					
Sesbania exaltata	Hemp sesbania		.06	.20						4.00-7.50	2.59± 1.93
Sesuvium maritimum	Purslane sesuvium					Good				7.60-7.90	19.58±14.43
Sesuvium portulacastrum	Coast sesuvium		.04			Good					
Setaria lutescens	Yellow bristlegrass		.06			Fair			Fair	5.00-7.50	5.58± 3.58
Setaria magna	Giant bristlegrass				.03	Fair				4.00-5.90	4.96± 3.36
Setaria geniculata	Knotroot bristlegrass					Good			Fair		
Solidago sp.	Goldenrod			.04	.08					4.90-7.80	1.81± 1.53
Spartina alterniflora	Smooth cordgrass	2.14	4.77	.86			Fair	Fair		4.50-8.50	15.19± 7.78
Spartina cynosuroides	Big cordgrass		.89	1.19	.02		Fair	Fair		4.30-6.90	8.78± 4.96
Spartina patens	Marshhay cordgrass	5.99	55.22	34.01	3.74		Good	Good		3.70-7.90	8.55± 6.33
Spartina spartinae	Gulf cordgrass	.01	.04	1.48						5.50-7.50	3.70± 0.59

Scientific Name	Common Name (2)	Vegetation Composition of Marsh Types (3)				Food Value To Wildlife (5)				pH Range (3)	Salinity Range (3) PPT
		Saline	Brackish	Intermediate	Fresh	Ducks	Geese	Furbearers (6)	Crawfish		
Spirodela polyrhiza	Common ducksmeat				.20	Fair			Fair	5.20-7.10	0.45± 0.00
Suaeda linearis	Annual seepweed	.23									
Taxodium distichum	Baldcypress				.02					4.90-5.90	1.90± 1.40
Typha angustifolia	Narrowleaf cattail						Fair	Good		3.70-8.50	3.93± 4.06
Utricularia cornuta	Horned bladderwort				1.68	Poor			Fair	4.60-5.90	0.69± 0.65
Vallisneria americana	American wildceelery		.08			Excel					
Vigna repens	Hairypod cowpea		1.20	3.84	1.43					4.00-7.20	3.85± 4.17
Woodwardia virginica	Virginia chainfern				.28						
Zizaniopsis miliacea	Giant-cutgrass				1.20	Poor			Fair	4.30-6.00	1.36± 1.90

1. Where a space is blank, a value is not known.

2. These follow "Standard Plant Names", Radford, Ahles & Bell" "Manual of the Vascular Flora of the Carolinas", or Hotchkiss "Underwater and Floating Leaved Plants of the U. S. and Canada", and "Common Marsh Plants of the U. S. and Canada".

3. This is adapted from Chabreck's "Vegetation, Water and Soil Characteristics of the Louisiana Coastal Region", Bulletin 664, LSU.

4. This is a standard deviation.

5. Food values taken from the following sources:
   T. O'Neil, Muskrats of Louisiana, 1949, La. Wild Life and Fisheries Commission, New Orleans, La.
   Martin, A. C., Uhler, F. M. Food of Game Ducks in the U. S. and Canada, Resource Report 30, USDI, Fish and Wildlife Service, 1951.
   Martin, A.C. Zim. H.S.,Nelson,A. L. American Wildlife and Plants, McGraw-Hill Book Co., N.Y. 1951
   Lynch, J. Common Waterfowl Food Plants of Louisiana. Inservice Publication.

   Personal communication with Ted Joanen, Dr. William Palmisano, Dr. Robert H. Chabreck, Dr. James Avault.

6. This is primarily muskrat and nutria foods.

SECTION III

ENGINEERING

General

Structures constructed on marsh soils have several serious problems which are not common to construction on other soils. These soils usually have a high organic or humus content and, as a result, a low bulk density. If exposed to the atmosphere under dry conditions, the organic material oxidizes. Where this material is a substantial portion of the soil, shrinkage and subsiding occur. Drainage ditches need to be deepened, and levees need to be rebuilt quite frequently. Where the subsiding and consolidation is irregular, surface drainage can become difficult. Structures which can be supported on deep pilings will remain level; however, sidewalks, driveways and unsupported porches will sink with the surface and crack. Pilings should be driven until a firm subsoil is reached. If possible, levees and other earthwork should be constructed without using the organic portion of the soil. The humus material on the surface should be removed down to the firm clay before construction is begun. Where it is necessary to use the organic material, maintenance operations should include replacement of this soil as it oxidizes. In some areas, the humus is too deep to allow removal and replacement. These areas should be avoided, if possible. If it is necessary to build roads or levees across these areas, it is usually not possible to complete the work in one operation. One method is to build on top of the mat of humus as high as possible without breaking through. Then, if this is allowed to firm up for six months to a year, a second lift can be added by hollowing out the center of the levee and using the material to build up the sides. The center is then refilled with the soft wet material from the borrow pit. It may be necessary to repeat this a third time. Another method is to build up a pile of material as high as possible without breaking through the top mat. This pile or dump should be wide enough to contain enough material to build the finished levee. About fifty percent extra should be included to allow for losses. After the dump has dried out and firmed up, the sides can be moved to the center to build it up higher. A third rebuilding may be necessary.

Caution should be used during construction not to break through the top layer of soil. Below it may be a watery layer of clay that will not support any weight. Material which slips through a break will continue to slide outward no matter how much is added. If a break occurs, the levee should be moved. If this is not possible, the break can sometimes be mended by driving willow poles or other readily accessible materials vertically

forming a gridlike pattern. Thin willow poles placed horizontally and tied to the vertical grid with wire will support the levee enough to continue operations. More lifts of material placed in thin layers may be necessary.

Breaks can be detected early by using settlement plates under the embankment. Plywood (3 ft. x 3 ft. x 3/4 in.) placed on top of the original surface can be checked periodically. When the subsiding begins to speed up, construction should be halted immediately until remedial steps can be taken.

If they are carefully constructed, stable levees can be built on areas containing 10 to 12 feet of humus. Buildings and other structures have been built on pilings in areas too deep to reach firm clay. The pilings are driven much closer together than normally and then allowed to firm up for several days. They are closely observed during later stages of building and supplemented if they sink too much. Often a soft spot can be bridged by tying together several rows of piling.

Drainage

Most farms in the marsh section have areas which are too low in elevation to drain by gravity. It is necessary to surround them with a protection levee and to remove the runoff with pumps and automatic gates. Pumping costs, usually in excess of $10 per acre per year, are continuing costs which occur whether there is a crop on the land or not. In some instances, part of the land can be drained by gravity alone. Diversion ditches should be used to drain this land outside of the levee system. On other farms, the land has enough elevation to partially drain by automatic gates. If they exist, both of these alternatives should be utilized to reduce the continuing cost.

Runoff from the remaining land must be conducted to a pump and lifted over the levee. The pipe bringing the water from the pump to the exterior of the levee system should pass through the levee at as low an elevation as possible. The discharge end of this pipe should be turned downward and extended to a point where it will be under water most of the time. This produces a siphon action which will reduce the required head to slightly more than the difference in elevation between the outside water level and the inside water level. A flap gate installed on the discharge will prevent the flow from reversing itself after the pump is shut down.

After levees, pumping plants, and flood gates have been provided, it is usually necessary to provide an interior drainage

system. The same systems used elsewhere are used for the particular crop being grown. If the organic matter hasn't been mixed with the mineral subsoil or lost through oxidation, ditches and plow drains should be kept clean and open. If the land near the channels is allowed to dry out before the center areas, it may rise and trap the water in the interior. Deep plow furrows are sometimes used to prevent this when the land is being farmed and, when it is idle, the water is allowed to remain on the surface. This also slows the oxidation process.

On some reclaimed land, the water table may be too high for crops. Perforated pipe has been used to correct this condition where the lateral drainage of the soil is free enough. This condition should be checked before planning such a measure. Heavy clay soils may require the spacing between pipe laterals to be too close to be practical. Crowns and corrugations are other helpful practices. These are large rows, 30' to 80' for corrugations and 60' and over for crowns. Runoff moves faster to the outlet ditches and does not have as much time to infiltrate as it would on flatland. Crowns have a small V-ditch between the rows, and corrugations use only the dead furrow for drainage.

Land which is drained by pumping should not remain flat broken for any longer than necessary before cultivation. Because they are part of the drainage pattern, the old rows should be left in the field or new ones should be built. In riceland, the plow furrow drains should be kept open and clean when the land is idle.

Specifications

Levees - Protection levees in the marsh should be built to an elevation compatible with planned land use and the degree of protection required. This can vary from an elevation associated with less than an annual frequency to that of a 100-year frequency. Settled side slopes should be 2-1/2 to 1 percent, or flatter. If the material used does not shape readily, the side slopes can be steepened to 1-1/2 to 1 percent, provided the base width is not reduced. The minimum top width should be six feet to eight feet, except where the top will be used as a maintenance road. Then the top width should be increased to at least 10 feet.

Borrow Pits - The borrow pit which supplies the material for the levee should normally be cut inside the impoundment to allow for its use as a drainage channel and also for storage. A berm of at least 10 feet should be left. In a deep humus soil, this width may be increased to 25 feet to impede seepage. In some areas it may be necessary to cut a core trench and backfill it with the best clay soil available.

Drainage Channels - Drainage channels within the protected area should be cut with slopes of 1-1/2 to 1 percent. On channels which will usually remain full of water, steeper side slopes may be used.

Walkways - If marshland is used for grazing, walkways or elevated roads can be used to give easy access to all parts of the fields. These should connect high areas or provide an elevated resting area which is easily accessible from the more remote areas of the farm. Walkways should be located so as to have as small an effect on the natural drainage pattern as possible. Borrow pits should be staggered, and culverts should be placed through the embankment where streams and natural channels are crossed. If it is necessary to use only one side of the embankment to obtain the material, earthen plugs (which should be kept at least 30 feet long) should be left in the borrow pits to prevent disturbing the drainage.

Wildlife Impoundments - Marshlands are sometimes developed for wildlife. Small, low levees can prevent the land from drying out. If natural streams exist, they can be controlled with weirs or dams. The crests of weirs can be set to maintain sufficient water to promote the growth of wildlife food. To control hunting, the levels can be controlled to deny or expose food. Impoundments with no outside drainage area do not need spillways. A simple, overflow type pipe structure with a manual gate to allow complete drainage should be used. The pipe and overflow should be capable of draining the excess water at a rate of 1/2 inch per day. If there is contributing drainage area outside the impoundment, an emergency spillway must be provided. The spillway should be capable of removing the runoff from a rainfall frequency of once in 10 years.

The spillway can be a properly vegetated or protected earthen notch cut on an undisturbed area, a concrete weir, a pipe provided with an elbow and riser, or a structure of treated timber.

The Engineering Field Manual for Conservation Practices and the Engineering Standards and Specifications for Conservation Practices in each SCS field office contain criteria and plans for various engineering practices used in the marsh.

Saline and acid conditions in most swamp or marsh areas severely restrict the use of materials. Materials other than polyethylene polyvinyl chloride, and treated timber require costly protection and may not be practical. Several marsh soils are corrosive to concrete and asbestos cement pipe. Materials used in marsh soils should be fully considered.

Recent legislation and court decisions have greatly increased the areas in the marsh in which a permit to conduct many operations is required. The landowner should be advised to contact the Corps of Engineers to determine if a permit is necessary.

SECTION IV

RANGE

Range Classification, Hazards and Management

General -

Range Definitions - Rangeland is land on which the climax (natural potential) plant community is composed principally of grasses, grasslike plants, forbs, and shrubs valuable for grazing in sufficient quantities to justify grazing use.

Rangeland includes natural grasslands, natural savannas, and wetlands suitable for grazing use. The natural plant cover of such wetlands is dominated by mixtures of grasses, grasslike plants, forbs, and certain shrub and chaparrel plant communities.

Range site - an area sufficiently uniform in soil, climate, and natural biotic conditions to produce a particular kind and amount of climax vegetation.

Range condition - is the present state of the vegetation compared with that of the potential natural vegetation for each site. Range condition has been called range health. Like health, condition is relative. If a particular range site is described as being in "good condition" or in "poor condition", the description is always relative to the kind and amount of native vegetation that that site is capable of producing. In range condition classification, four classes are used to express the degree to which the composition of the present plant community has departed from that of the potential natural plant community. The four range condition classes are defined as follows:

Condition Class	% of Climax Vegetation Found Presently on the Site
Excellent	76-100
Good	51-75
Fair	26-50
Poor	0-25

Land operators normally want their ranges in excellent or good condition, because such ranges have the most cover for soil conservation. They yield more grazing than ranges in fair and poor condition. A range site and condition inventory is made on rangeland as a basis for assisting the operator in planning correct range development and practices. The better

native grasses are maintained or increased through sound livestock management practices. Since animals are selective grazers, they constantly eat the more palatable, nutritious grasses and leave the less palatable ones to increase. Under severe use, even these plants are taken out, and undesirable species of little or no forage value invade the range.

Range conditions are classified according to the number of natural potential grasses or better plants which are present. Climax plants are those which nature has found to be the most suitable for each kind of land or range site. Numerous studies have shown that climax plants are generally the most preferred by livestock.

Potential natural vegetation - that group of plants that will form a stable community within a reasonable amount of time after man and his influences have been removed.

Decreasers - plants in the climax which decrease under continued overgrazing.

Increasers - plants in the climax which increase for a time because of overgrazing. With continued overgrazing, they too begin to decrease.

Invaders - plants not present in the climax, but which enter or invade areas disturbed by overgrazing or other means.

Key forage plant - a plant, usually a grass, that is preferred most by cattle during a particular season. It is usually a decreaser or increaser species producing 15-20 percent of the total forage by weight. Proper grazing use should be based on the key plant.

Hazards in Cattle Operations

Hazards in the marsh area include insects, disease, high water from heavy rainfall and storm tides that submerge grazing areas, lack of shelter, prolonged drought, unstable soil where cattle may bog, and extremes in temperatures.

Insects, especially mosquitoes, are a serious problem during summer months, particularly on salt marshes. Cattle may be killed by mosquitoes during severe infestations. For this reason salt marshes are considered best suited for winter use.

High water from heavy rains and storm tides flood marshes, forcing cattle to high ground. This results in overgrazing of the high land. Livestock lose weight under these conditions and are more susceptible to communicable diseases.

Prolonged droughts occur that reduce forage production. This results in overuse, intensifying food needs that must be met by purchasing feed, by moving livestock to another source of feed, or by liquidating part of the herd.

Cold north winds in the winter and high temperature in the summer are detrimental to livestock condition. Shelter should be provided to overcome these hazards.

Boggy areas such as sloughs are a hazard to cattle. Prolonged high water may make large areas of the marsh boggy, resulting in significant death loss of cattle.

Managing Marsh Rangelands -

Range management practices - Balancing livestock numbers with forage production range site and condition surveys are used to determine present and potential production of marsh rangelands. This survey is used as the basis for balancing livestock numbers with forage production. Safe-starting stocking rates are determined from the survey. They are used as a starting point to obtain proper use. These are not rigid and must be adjusted periodically as conditions change. The need for additional forage is pointed out here. Areas that are inaccessible due to bayous and sloughs are recognized. Practices that will make these areas available for grazing or that will improve the conditions of the range to help balance livestock with forage production are identified.

Range proper use - means grazing at an intensity that will maintain or improve the quality and the quantity of the desirable vegetation. This is normally 50 percent by weight of the current growth of the key plant or plants.

Proper use is judged at or near the end of the grazing season. Grazed plants are compared to similar ungrazed plants to determine degree of use. Use less than 50 percent by weight is considered proper use.

Range deferred grazing - involves resting the ranges during the major growth period of the key plants to encourage improvement through increased plant vigor,

vegetative increase through rhizomes and stolons, and from seed production. Deferred grazing helps to provide a forage reserve for emergency use.

Aids to Range Management -

Cattle walkways - The number and distribution of the low coastal ridges in marsh range have a profound influence on distribution of livestock grazing. Cattle stay on or near these ridges when water covers the marsh. They serve as places for the cattle to rest and to leave young calves while grazing. Ridges are the only places where cattle can be cared for and fed during times of emergency.

Ridges and adjacent areas are usually severly overused, while more distant range is properly used, and remote areas may be used too little or none at all. During prolonged wet seasons, many ridges are severely overgrazed even though the range as a whole is properly stocked.

Uniform range use can be achieved through construction of "cattle walkways". Walkways are earthen levees constructed from ridges into marsh areas to improve accessibility of the marsh vegetation and to encourage uniform use of it. They serve as trails, bedground, calving locations, and a resting place for young calves while mothers graze. They enable the livestock operator to work his cattle at any season of the year. Walkways also provide refuge from high water due to heavy rains and storm tides. They afford some relief from mosquitoes.

Borrow pits from which earth is taken to build the walkways are staggered from side to side of the levee at intervals of several hundred feet. This permits cattle to move off to graze from either side. Staggered pits also prevent the flow of water off the range. When the walkways are built along a range boundary, the earth can be taken from the boundary side of the levee. Plugs of earth are left in the pits at intervals to prevent the flow of water. Walkway pits along range boundaries are effective firebreaks to help in the control of marsh fires. They also act as resting and sometimes feeding areas for waterfowl and den sites for furbearers.

Bridges or culverts are provided whenever the walkways cross natural drains. By staggering pits or leaving plugs in boundary pits and installing bridges, interference with natural water conditions is kept to a minimum. Movement of water over the marsh is not materially altered by walkways that are properly constructed.

Permits for construction must be acquired from the U.S. Corps of Engineers before any construction is attempted.

Fencing - is needed to distribute grazing and facilitate livestock and forage management. A four-strand barbed wire fence is normally sufficient. Posts should be treated. Protect fences from fire. Burning damages the galvanized coating, causing the wire to rust out in a short time. Fences should be located so as to separate range sites in order that different management can be applied.

Livestock watering facilities - Livestock water is needed on many ranges. Water in bayous, ponds, and pits often becomes too salty in summer for cattle to drink. Fresh water from wells is the most dependable source of water for livestock use. Deep ponds on ridges are successful where soil conditions favor construction. Availability of fresh water in borrow pits along walkways helps to keep cattle from overusing areas around permanent water during the spring months. However, water in borrow pits may become unfit for animals in prolonged dry periods.

Earthen windbreaks - have been devised to protect cattle from severe cold, wet winds in the winter and to aid in grazing distribution. These structures are generally 100 feet long, with wings of 75 foot length, giving them a "horseshoe" shape. They are six to seven feet high and open to the south. Any trees or brush invading these windbreaks increase their effectiveness.

The soil for construction is taken from the back (north) side. The borrow pits created serve as watering places for livestock.

A structure of this size will give protection to 100 head of grown cattle during a severe weather period. Grazing distribution is improved by installing one structure per 100 head of cattle. This is especially true when the windbreaks are tied in with a system of cattle walkways.

Controlled burning - This practice is widely used in marsh areas. Stockmen and trappers burn off the dense cover of mature marsh vegetation to stimulate new, succulent growth for both cattle and wildlife and to increase the availability of forage. Vegetation is severely damaged by burns in periods of drought when fire can reach plant crowns and roots.

Uniform grazing, walkways, pits, and canals are all useful in controlling unplanned or accidental burns.

Cattlemen attempt to burn the same area every other year at a time when the ground surface is covered with water.

Supplemental feeding - Supplemental feeding or improved pastures are necessary on most marsh range operations to provide an adequate twelve-month forage supply. Paille fine marshes produce little green forage during cold weather. Forage left from the growing season weathers rapidly and soon becomes unsatisfactory for feed. Unless warm weather brings new growth, cattle must be moved to tame pastures or higher land, or they must be fed hay and concentrates on the range. Too often supplemental feeding is delayed until cattle have lost considerable weight.

If supplements are not provided, they may be afflicted by rickets, a calcium-phosphorous imbalance or deficiency. Steamed bone meal or oyster-shell flour supplements will help avoid this disease. These minerals should be available on a free choice basis all year long.

Where giant cutgrass and common reed make up a large percentage of the fresh marsh vegetation, forage quality usually holds up better during winter months. However, some feeding is desirable during critical periods.

Cattle do well on salt marsh ranges during winter months except during prolonged droughts, severe storms, or freezing weather.

During severe weather, protein supplement and roughage should be provided. At other times, some protein should be made available to cattle grazing on mature vegetation. This is generally not required if cattle have access to areas that have been control burned.

Insect control - Insects, especially mosquitoes, become so intolerable during the summer that cattle must be moved from a large portion of salt marsh range to grazable woodland or pastures during the summer months. Salt marsh range is grazed mostly from mid-October until mid-April. Most summer grazing is provided by fresh marsh range and improved pastures or idle riceland. Several successful cattle operations are based on using marsh range for the six-month winter period and pine woodland for six months during the warm season. The herds are trailed or trucked between the range areas each October and April. Trailing herds for distances of 65-70 miles is still being practiced by some operators.

Some cattle operators build "smokes" for their cattle when mosquito outbreaks occur. The smoke repels the mosquitoes, giving temporary relief. Insecticides provide relief in mosquito control districts, but unfortunately all marsh areas are not covered by these districts.

Production Practices -

Brush control - Aerial spraying with chemical mixtures is used to control rattlebox and sesbania, two weedy legumes. Conventional and shredding mowers are used to control annual weeds, small brush and coarse grass on ridges. Diesel fuel is very effective on palmetto when applied at the rate of two tablespoonfuls in the center of the plant.

Management which favors the better forage plants is the best overall weed control.

CAUTION: If herbicides are handled or applied improperly, they may be injurious to humans, domestic animals, desirable plants, and fish or other wildlife; and may contaminate water supplies. Follow the directions and heed all precautions on the container label. (For details on brush control, see Brush Management (314) in Sec. 4, Rangelands of the Technical Guide.)

Water control - Salt water from the Gulf periodically intrudes into the marsh area through rivers, bayous, and drainage and transportation canals. A marsh that is classified as salt marsh range can be greatly damaged by water with heavier concentrations of salt. In drought periods, when the movement of fresh water to the Gulf is severely reduced, salt water sometimes flows up the drainage canals. Heavy south winds blow salt water inland for considerable distances, causing it to spread over marsh range areas adjacent to the drains. Salt water sometimes fills freshwater lakes during periods of high wind tides and when water levels in the lakes are low. As the water evaporates, salt concentrations become so great that soils and vegetation are both damaged, and various forms of aquatic wildlife habitats may be destroyed.

Soils that are saturated with fresh water before the salt water comes in are not usually damaged. Heavy soil which is dry prior to being flooded with water absorbs considerable salt. These salt accumulations kill less salt-tolerant plants and cause fine textured mineral

and organic soils to become unstable. Productivity of such areas is greatly reduced, and they may actually become hazardous to livestock.

Gates and levee systems are needed in some areas to protect the marsh against salt water and high tides.

Ecological Site Description

Local Name - Salt Marsh

Location - Gulf Coast Marsh

Topography and Elevation - The relief is flat or concave, with slopes of less than .5 percent. Elevation ranges from +2 to -2 feet mean Gulf level. Minor differences in elevation have a great effect on dominant vegetation.

Soils - The soils of the salt marsh consist of deep, fine-textured materials with some deposits of peat or muck over a mineral substratum. Runoff is very slow due to the elevation. Permeability is very slow, with no internal drainage.

Soil Series - that characterize this site are:

Andry
Harris
Placedo

(For details on these soils, see the Soils section of this handbook.)

Potential Natural Plant Community - Potential natural plant community composition and productivity is essentially a grass-forb (grass - 76 percent, forbs - 25 percent) community that is tolerant to high salinity and frequent flooding by wind and lunar tides. This community has been formed under a long frost-free growing season with a super abundance of moisture. This vegetation starts at the edge of the Gulf in some cases 1/ and extends inland from .5 to 23 miles. The further inland it extends, the less salinity and tidal flooding this community receives.

When in good condition, the average annual growth produced per acre on this site is 8,500 pounds of air-dry herbage per acre. Under a poor condition class, only 4,000 pounds of air-dry per acre can be expected.

The main constituents of this marsh are smooth, marshhay and big cordgrass, seashore saltgrass, saltmarsh and Olney bulrush, common reed and seashore paspalum. Smooth and marshhay cordgrass and seashore saltgrass are the most numerically abundant.

Decreaser plants are marshhay, big and smooth cordgrass, common reed and Olney bulrush. Three increasers that are productive forage plants are longtom, seashore paspalum and seashore saltgrass. Other increasers include torpedograss, seashore dropseed, needlegrass rush, Gulf cordgrass, California bulrush and others.

1/ Some areas have an intervening barrier beach community between it and the Gulf.

Principal invading species are annuals such as fall panicum, cockspur, pluchea and others. Perennial invaders include slim aster, smartweeds, dogfennel, bigleaf sumpweed and rattlebox. The latter two are woody plants which greatly reduce forage production.

Potential Natural Animal Community - This potential natural plant community provides a potential habitat for the following species of wildlife on a yearlong or seasonal basis. The dominant species being:

Mammals	Resident	Migratory	Density (number per acre)
Whitetail deer	x		1/300
Muskrat	x		1/6
Nutria 1/	x		1/6
Raccoon	x		1/300
Otter	x		1/200
Mink	x		1/15
Swamp rabbit	x		1/10 to 1/2.5'
Reptiles			
Alligator 1/	x		30/sq. mi.
Birds			
Ducks	x	x	- 2/
Geese	x		- 2/
Wading birds	x	x	-
Shore birds	x	x	-
Song birds	x	x	-
Coots and rails	x	x	-

1/ Lives in the less saline part of this zone; most abundant in the fresh marsh.

2/ Data not available.

Interpretations

For Grazing of Domestic Livestock - This site can be used for grazing wherever soils are firm enough to support them. Mosquitoes are a problem during the late spring, summer and early fall. Most cattle are removed from the marsh during this time and taken to the piney woods. In some instances, cattle raised on marshland have been afflicted by rickets. To be safe, mineral supplements should be made available the entire time they are in the marsh area.

To assure better utilization of the marsh grazing resource, cattle walkways should be constructed. These "ramp-like" structures allow two square miles to be grazed for every linear mile constructed. These areas are also used for resting, bedding, calving and offer some relief from mosquitoes.

Another structural item needed in the marsh is earthern windbreaks. These are U-shaped structures, with the borrow areas on the outside, and the open end pointing south or southeast.

The following is a guide for estimating the range condition of a salt marsh site.

DECREASERS	INCREASERS	INVADERS
Plants that decrease when range is overgrazed. In rating range condition count all found on the site.	Plants that increase when range is overgrazed. In rating range condition, count no more than the percent found in Potential Natural Plant Community as indicated below.	Plants that invade the site when range is overgrazed. None are counted in rating range condition.
Marshhay cordgrass	Seashore saltgrass - 30	Annuals
Smooth cordgrass	Gulf cordgrass - 10	Slim aster
Big cordgrass	Longtom - 10	Devilweed aster
Common reed	Seashore paspalum - 10	Rattlebox
Olney bulrush	Rushes & sedges - 10	Bigleaf sumpweed
Bushy sea-oxeye	Seashore dropseed - 10	Eastern Baccharis

ESTIMATED YIELDS AND INITIAL STOCKING RATES

	Range Condition Class			
	Excellent	Good	Fair	Poor
Estimated lbs/ac Herbage (air-dry)	8,500	6,500	5,200	4,000
Initial Stocking Rate-Ac/AU/yearlong	4	6	8	12

Constraints that must be dealt with in planning the use and management of these forage resources for livestock grazing:

Constraint Ratings		
Mosquitoes	Flooding	Trafficability
Severe during late spring, summer, early fall.	Severe during storms	Moderate

Wildlife - The saltmarsh site covers the saline, brackish and the intermediate marshes, and a wide variety of animal life. Some of these animals are much more abundant in one of the subdivisions of this site. Below you will find a table displaying the preference these animals have for these areas.

Species	Most abundant	Moderate populations	Least abundant or absent
Whitetail deer	3	2	1
Muskrat	2	1,2	
Nutria	3	2	
Raccoon	3	2	1
Otter	3	2	1
Mink	3	2	1
Swamp Rabbit	3	2	1
Alligator	3	2	1
Ducks	3	2	1
Geese	2		1,3
Wading Bird	3	2	1
Shore Birds	1,2		3
Song Birds		1,2,3	
Coots & Rails		1,2,3	

1. Saline
2. Brackish
3. Intermediate

Constraints to be dealt with in managing this site for wildlife.

	Constraint Rating	
Soil	Flooding	Predators
Moderate	Severe during storms	If abundant, alligators can be very detrimental

Ecological Site Description

Local Name - Fresh Marsh

Location - Gulf Coast Marsh

Topography and Elevation - Relief is flat or concave. The area is nearly flat with slopes of less than .5 percent. Elevations range from 0 to 5 feet above mean gulf level.

Soils - The soils are pure to mixed peat, muck and mineral material. The surface ranges from peat to a dark gray or black clay, and from very strongly to slightly acid. The water table is near or above the surface during most of the year. Fresh marsh site soils are generally firm (particularly in southwest coastal marshes) enough to permit their use by livestock.

Soil Series - that characterize this site is:

Harris (non-saline)

(For details on this soil, see the soil section of this handbook.)

Potential Natural Plant Community - The potential natural plant community composition and productivity is essentially a grass-forb community with a small percent of woody vegetation present (grass-36 percent, forbs-63 percent, and woody-1 percent). This community is very intolerant to salinity. When it is flooded by sea-strength water, the whole community is destroyed for quite some time. Generally, this area is flooded by runoff from the uplands.

The most common plants to be found in this site are: alligatorweed, coastal waterhyssop, fragrant flatsedge, waterhyacinth, spikesedge, pennywort, sprangletop, maidencane (paille fine), common reed, bulltongue, marshhay cordgrass, cattails, hairypod cowpea, and gaint cutgrass.

Principal decreaser plants are maidencane, gaint-cutgrass, common reed and savannah panicum. Cutgrass is an indicator of firm soil conditions. Maidencane will grow under soil conditions ranging from mineral clays to "floating" organic marsh.

Increaser plants include longtom, torpedograss, needlegrass rush, California bulrush, alligatorweed, and bulltongue arrowhead. Longtom is the most important forage plant among increasers. Smartweeds, asters and annuals are prominent invaders. Rattlebox is a woody invader which appears with overuse conditions and greatly reduces forage production.

This site is capable of producing as much as 10,000 pounds of air-dry herbage per acre when in excellent condition, and as little as 5,000 pounds when the condition class is poor.

Potential Natural Animal Community - The fresh marsh site provides a potential habitat for the following species of wildlife on a permanent or seasonal basis:

Mammals	Resident	Migrant	Density number/acre
Whitetail deer	x		1/300
Muskrat	x		1/6
Nutria	x		1/6
Raccoon	x		1/300
Otter	x		1/200
Mink	x		1/15
Swamp rabbit	x		1/2
Reptiles			
Alligators	x		19/mi.
Birds			
Ducks	x	x	1/200 1/
Geese		x	- 2/
Wading birds	x	x	-
Shore birds	x	x	-
Song birds	x	x	-
Coots and rails	x	x	-

1/ Mottle ducks

2/ Data not available

Interpretations

The fresh marsh is used for grazing during the fall, winter, and early spring. The rest of the year the mosquitoes are too abundant. The soils of this fresh marsh site are generally firm enough for cattle, but soft spots may be present which will not be usable.

To assure that the cattle receive adequate nutrition, mineral supplements should be available on a year-round basis.

Walkways should be constructed to gain the most complete utilization of the marsh as possible. Earthen windbreaks are also desirable adjuncts to a complete range operation.

Below is a guide used to estimate the range of a fresh marsh.

DECREASERS	INCREASERS	INVADERS
Plants that decrease when range is overgrazed. In rating range conditions count all found on the site.	Plants that increase when range is overgrazed. In rating range condition count no more than the percent found in climax as indicated below.	Plants that invade the site when the range is overgrazed. None are counted in rating range condition.
Maidencane	Longtom - 10	Annuals
Giant cutgrass	Rushes and sedges - 10	Rattlebox
Common reed	Bulltongue arrowhead - 10	Willow
Savannah panicum	Alligatorweed - 10	Eastern baccharis
Switchgrass		Bigleaf sumpweed
Eastern gammagrass		Yankeeweed
		Smartweeds

ESTIMATED YIELDS AND INITIAL STOCKING RATES

	Range Condition Class			
	Excellent	Good	Fair	Poor
Estimated lbs/ac Herbage (air-dry)	9,850	8,000	7,000	5,000
Initial stocking Ac/AU/yearlong	3	4	6	10

Constraints that must be dealt with in planning the use and management of the forage resource:

Constraint Rating		
Mosquitoes	Flooding	Trafficability
severe during late spring, summer and early fall	severe during major storms or prolonged rains	moderate

Interpretations

Wildlife - The fresh marsh abounds in various forms of wildlife. It has the highest populations of alligators, deer, nutria, ducks and wading birds.

In this fresh marsh site, with its firm soils, management can be accomplished without undue difficulty. Water control of this marsh type is necessary and water control structures can be installed readily. Draining of this marsh during the summer months and controlled burning are most desirable practices to improve this area for wildlife.

Constraints that must be dealt with in planning the use and management of the forage resource:

Contraint Rating
Flooding
severe during major storms and prolonged rains

Information On Individual Marsh Plants

Analysis of Several Marsh Range Forage Plants

Plant	Growth Stage	% Crude Protein	%P	%Ca
Maidencane (paille fine) (Panicum hemitomon)	young	18.31	.21	.19
	bloom	16.75	.19	.60
	mature	--	---	---
	dormant	9.42	.08	.18
Giant cutgrass (Zizaniopsis miliacea)	young	15.50	.18	.58
	bloom	13.94	.17	.75
	mature	12.00	.16	.78
	dormant	6.0	.08	.48
Common reed (Phragmites communis)	young	17.16	.22	.21
	bloom	13.86	.15	.37
	mature	--	---	---
	dormant	11.31	.09	.16
Longtom (Paspalum lividum)	young	13.11	.23	.34
	bloom	10.25	.17	.57
	mature	--	---	---
	dormant	6.56	.12	.50
Marshhay cordgrass (Spartina patens)	young	12.74	.17	.17
	bloom	7.50	.10	.22
	mature	5.42	.10	.26
	dormant	--	---	---
Big cordgrass (Spartina cynosuroides)	young	12.33	.22	.18
	bloom	6.16	.15	.49
	mature	6.56	.12	.60
	dormant	5.19	.09	.27
Smooth cordgrass (Spartina alterniflora)	young	11.09	.20	.35
	bloom	7.81	.17	.53
	mature	9.50	.17	.74
	dormant	--	---	---

Analyses were made by Regional Operations Laboratory, Soil Conservation Service, Fort Worth, Texas in 1950. Samples were collected monthly during 1950.

SECTION V

SOILS

General

All Louisiana Coastal Wetland soils have the common characteristics of wetness, flooding, low elevation and low relief. They vary widely in many other characteristics, however, that are important to their use and management. Unfortunately, these characteristics are not evident from surface features or vegetation and require soil borings and examination to determine their nature. Soil surveys made by the Soil Conservation Service, U.S. Department of Agriculture, in cooperation with the Louisiana Agricultural Experiment Station, are based upon subsurface examinations and can provide much vital information for land use decisions in the coastal wetlands.

In addition to wetness and flooding, considerations most important to use and management of soils of the coastal wetlands are: (1) mineral content, (2) organic content, (3) subsidence potential, (4) consistence, (5) salinity, and (6) content of logs and stumps. Each of these are discussed separately.

Mineral Content - Mineral particles are essentially finely-divided rock fragments of sand or silt size along with still smaller particles of clay minerals. Soils that are dominated by mineral particles are called mineral soils. The layers of mineral soils are described in terms of soil textures such as clay, silt loam, sandy loam, etc. Most soils of Louisiana's Coastal Wetlands are mineral soils, however, large areas of the coastal wetlands are dominated by organic material and are classified as organic soils. Most mineral soils are far superior to organic soils for most uses.

Organic Content - Soil organic matter is the decomposed or partially decomposed plant remains that make up part of the soil. Materials that contain more than 20 to 30 percent organic matter (dry weight basis) are classified as organic soil materials and commonly referred to as peat, muck, or "coffee grounds". Soils that have organic surface layers more than 16 inches thick are classified as organic soils (Histosols - Soil Survey Staff, 1974. Table 1, page 12, gives the classification of Louisiana Coastal Wetland soils.) An important feature of organic soils is low bulk density (weight per unit volume). Comparative values are as follows:

Material	Bulk Density (gm/cc)
water	1.0
mineral soil	1.2-1.7
organic soil	0.15-0.5

The low bulk density reflects the small volume of mineral matter in organic soil material (Lynn, McKinzie and Grossman, 1974). The mineral content of representative organic soil material is about 6 percent on a volume basis compared to about 50 percent for a representative mineral soil (fig. 1).

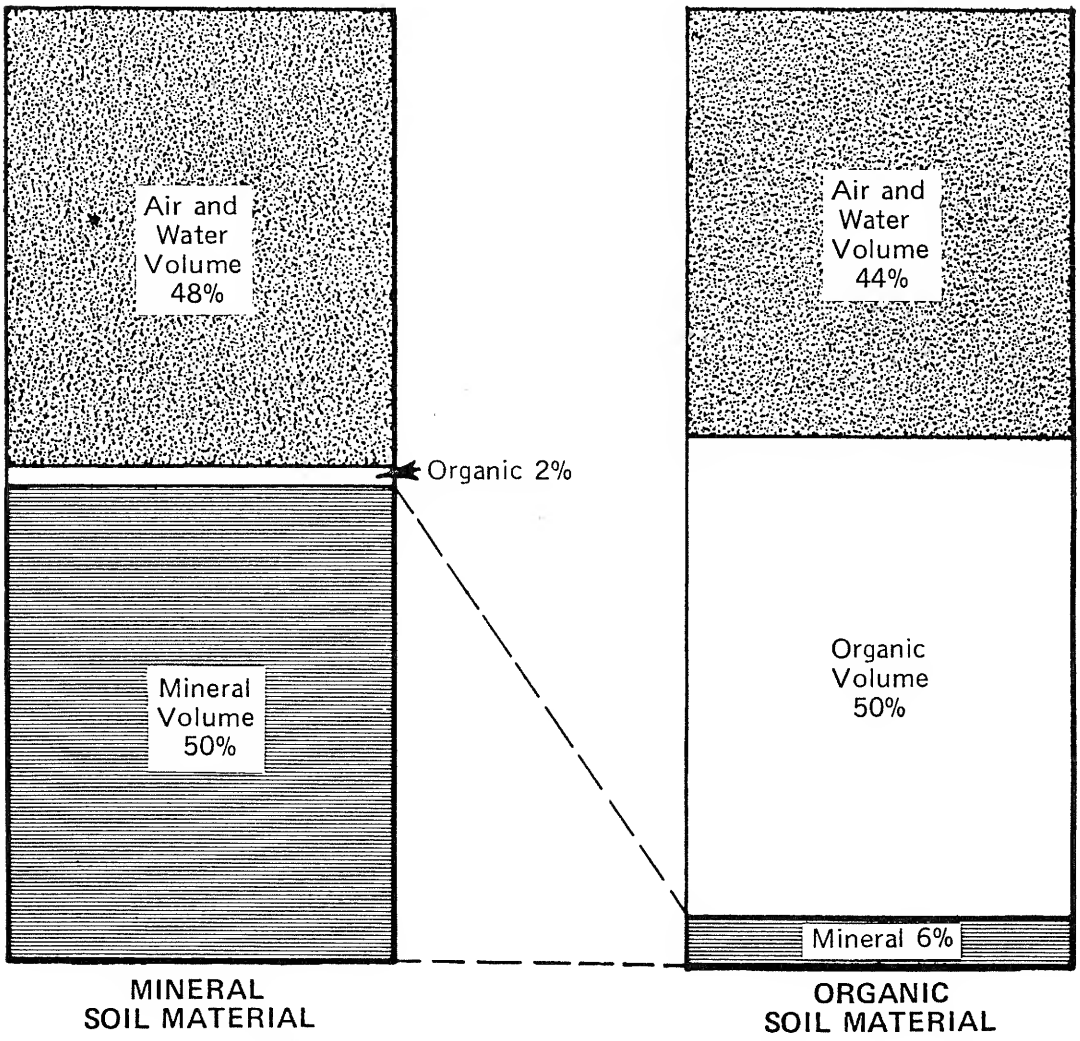


Figure 1 - Comparison of volume of mineral matter in organic and mineral soil material (air dry).

The remainder of the volume is organic matter, pore space filled with air, and water. This accounts for compressibility under load, volume change on drying (fig. 2), and general instability when used as foundation material. Organic soils, if drained, will eventually lose the 94 percent of their volume which is attributed to the decay of the organic matter and the loss of pore space. This results in a loss of surface elevation.

Figure 2. - Large shrinkage cracks in levee constructed from organic soil material.

Subsidence Potential - The possible loss of surface elevation after a soil with organic or semifluid mineral layers is drained, is called subsidence potential (Stephens and Speir, 1969). This does not take into account geological subsidence which is estimated to be 0.5 to 0.8 feet per century for the area. Subsidence of organic soils after drainage is attributed mainly to four factors:

(1) loss of groundwater buoyancy, (2) consolidation, (3) compaction, and (4) biochemical activity. Elevation loss due to the first three factors is termed initial subsidence and is normally accomplished in about three years after lowering the water table by drainage. Initial subsidence of organic soils will typically result in a reduction of thickness of the organic materials above the water table by about one-half. After initial subsidence, shrinkage will continue at a fairly uniform rate due to biochemical oxidation that causes the organic materials to disintegrate. This is termed continued subsidence and will progress until mineral material or the permanent water table is reached. The large volume of organic matter and water and low mineral volume (fig. 1) are responsible for subsidence potential of organic soils when drained. The rate of continued subsidence depends upon the thickness of organic material and the depth to water table. The rate of subsidence of drained organic soils in the coastal wetlands areas is reported to range from 0.5 to 2 inches per year. Measurements from a site in Florida (fig. 3) show 54 inches of subsidence in 48 years.

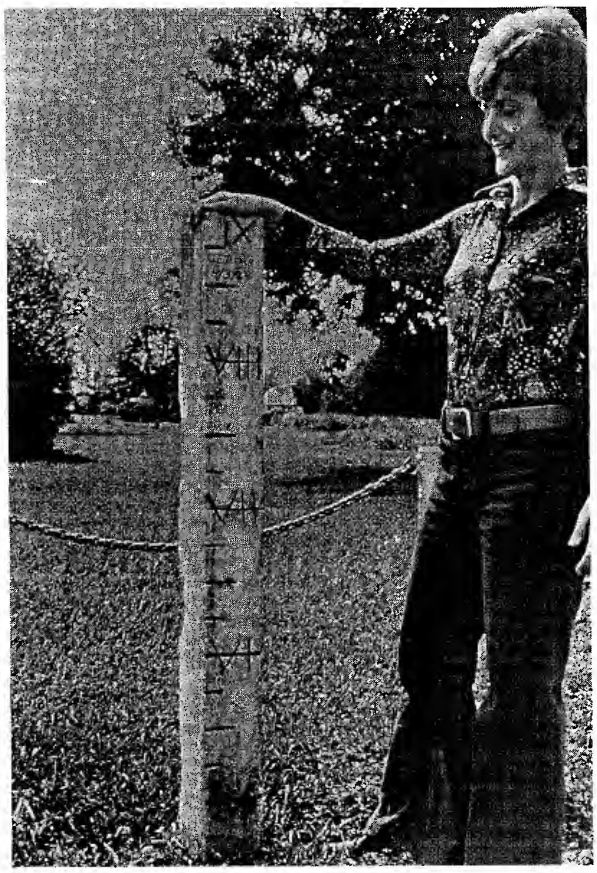


Figure 3. - Continued subsidence of 54 inches from 1924 to 1972 in a drained organic soil in Florida. In 1924 the post was at ground level.

Soils with semifluid mineral layers but without organic layers have a potential for intital subsidence due to loss of water and consolidation after drainage. They have little, if any, subsidence potential thereafter. Subsidence of mineral soils is minor and generally is not considered to be a serious limitation to use.

Total subsidence potential of Louisiana Coastal Wetland soils range from less than 3 inches to more than 20 feet. Total subsidence potential for some representative Louisiana soils are as follows:

Soil Series	Total Subsidence Potential
Harris	0
Andry	8 to 15 inches
Delcomb	18 to 50 inches
Lafitte	51 to 240 inches

Soils are rated (Table 1) according to total subsidence potential as a result of drainage (Regional Planning Commission, 1970). The ratings are:

low - 0 to 3 inches
medium - 3 to 15 inches
high - 15 to 50 inches
very high - more than 50 inches

Subsidence of organic soils is a severe limitation for most urban uses (Regional Planning Commission, 1970). Organic soils around structures built on piling will subside when these soils are drained and developed for urban uses (fig. 4). Foundations will be exposed and unsupported driveways, porches, and sidewalks will crack and gradually drop below original levels if not supported by piling or bridging. Underground utility lines and pipes will break. Driveways will subside to the extent that it will not be possible to drive a car into a carport. Concrete foundations originally below the surface, will be exposed as much as several feet above the surface. In 10 to 15 year old subdivisions on organic soils, the effects of subsidence are readily apparent (fig. 5).

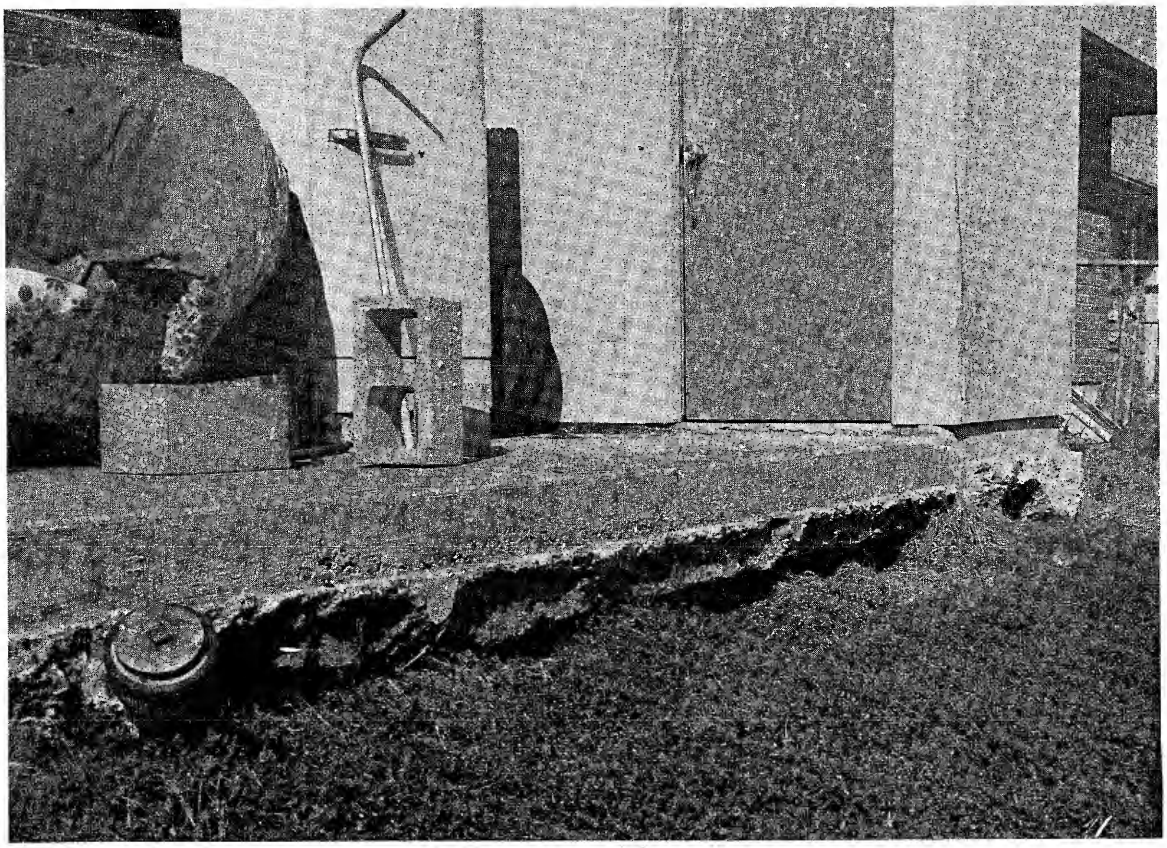


Figure 4. - Subsidence of organic soil below house foundation.

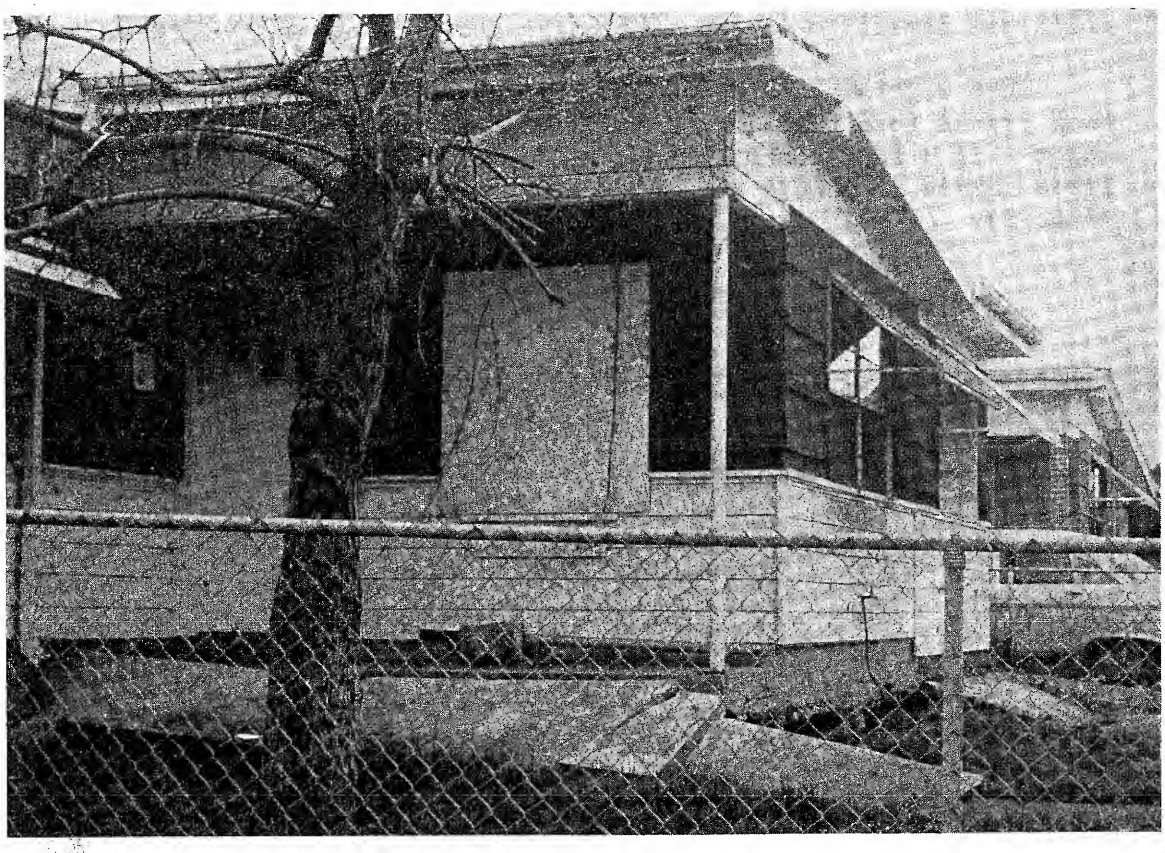


Figure 5. - Settlement of concrete work around house due to subsidence or organic layers of drained Kenner soils.

Drainage ditches are affected by subsidence through a reduction in ditch depth. For example, a drainage ditch dug 10 feet deep may be only 5 to 7 feet deep after initial subsidence. Continued subsidence gradually reduces the depth still further and the ditch capacity is reduced. If the ditch is deepened to restore the original capacity a new increment of initial subsidence takes place.

Consistence - The attributes of soil material that are expressed by the degree of cohesion and adhesion or by the resistance to deformation or rupture are termed consistence (Slusher, Cockerham, and Matthews, 1974). Consistence of mineral layers varies widely in coastal wetland soils. It is related to the percent of water at field state (Pons and Zonneveld, 1965). Clayey mineral layers

in Harris and Placedo soils are firm and have less than 100 percent water at field state. Scatlake soils are semifluid to depths of 40 inches or more and have 100 to 250 percent water. Gentilly soils are semifluid in the upper part and firm below 40 inches.

When Scatlake soils are drained they dry and shrink irreversibly. Deep cracks form that do not close when the soil is rewet. The upper 2 or 3 feet become firm but the layers below the water table remain semifluid and are unstable material for foundations (fig. 6).

Figure 6. - Using boards to provide support for sewer tile in semifluid subsoil. The surface has consolidated and become firm as a result of drainage.

Undrained soils with thick semifluid surface layers are too soft to support livestock for grazing. They are unsuitable for foundations for roads, buildings, or water-control structures without special and often costly measures.

Salinity - Salinity of coastal wetland soils ranges from less than 0.5 percent of the landward side to more than 2 percent salt near the Gulf. Salinity influences the coastal wetland vegetation which in turn influences the wildlife habitat and the plants available for cattle range. Soils high in salt content have both physical and chemical properties that are unfavorable for most cultivated crops. In addition to levees, pumps and an internal drainage system, the removal of excess salts by flushing and leaching with fresh water may be required for crop production.

Soil salinity classes based on the electrical conductivity of the saturation extract are given in Table 1. Conductivity is expressed in millimhos per centimeter (mmhos/cm) and part per thousand at 25 degrees Celsius. The following is a list of the salinity classes and their conductivity:

Salinity Class	Conductivity (mmhos/cm)	ppt
None	less than 2.0	less than 1.25
Low	2.0-4.0	1.25-2.5
Moderate	4.0-8.0	2.5-5.0
High	8.0-16.0	5.0-10.0
Very high	more than 16.0	more than 10

Logs and Stumps - Some organic soils in the coastal wetlands area were formed from the remains of woody plants such as baldcypress and water tupelo. Maurepas soils were formed from such material and contain many logs and stumps below the soil surface. In other soils, sediments have covered logs and stumps leaving them buried and not evident from surface observations. Buried logs and stumps are characteristic of certain soils. The logs and stumps interfere with excavation and in organic soils result in irregular subsidence (fig. 7).

Figure 7. - Irregular subsidence of an organic soil that contains buried logs.

Soil Interpretations

Table 1 shows ratings for coastal wetland soils that are important to land use and management decisions. These ratings and interpretations include: (1) classification as being mineral or organic, (2) subsidence potential, (3) salinity, (4) wetland type, (5) suitability for cattle grazing, (6) cropland potential,(7) wildlife suitability, and (8) development difficulty. The first three items are discussed in the above sections. The following is a brief discussion of the remaining items.

Wetland Type - It is important that people making land use decisions and recommendations have an understanding of the various ecological types of wetlands. The U.S. Fish and Wildlife Service has described 20 wetland types. (For the definition of each of

TABLE 1

CLASSIFICATION, CHARACTERISTICS, AND INTERPRETATION OF WETLAND SOILS

Soil	Classification	Subsidence Potential (inches)	Salinity	Wetland Type	Suitability For Cattle Grazing	Cropland Potential	Wildlife Habitat Development Potential	Development Difficulty
Allemands	organic	high	none to low	12	not suited	low	poor	4
Andry	mineral	medium	moderate to high	18	suited	very low	fair	1
Barbary	mineral	medium	none to low	6,7	not suited	moderate	poor	2
Carlin	organic	very high	none to low	13	not suited	very low	poor	5
Delcomb	organic	high	moderate to high	18	not suited	very low	poor	3
Fausse	mineral	low	none	6,7	suited	moderate	good	1
Gentilly	mineral	medium	low to moderate	12	not suited	very low	fair	1
Harris	mineral	low	moderate to high	15,18	suited	very low	fair	1
Harris Non-Saline	mineral	low	none to low	12	suited	moderate	good	1
Kenner	organic	very high	none to low	12	not suited	very low	poor	5
Lafitte	organic	very high	moderate to high	18	not suited	very low	poor	5
Maurepas	organic	very high	none to low	7	not suited	very low	poor	5
Placedo	mineral	low	high to very high	16	suited	very low	fair	1
Scatlake	mineral	medium	moderate to high	15,18	not suited	very low	poor	2

these types that are shown in Table 1 see "Wetlands of the United States", U.S. Fish and Wildlife Service circular 39.)

Suitability for Cattle Grazing (see Range section.) - Suitability for cattle grazing is determined by the soil trafficability or its ability to support cattle. Some soils are too soft to support cattle while others provide good footing and adequate support for cattle when grazing. The trafficability of many coastal wetland soils vary with bulk density of the soil. The ratings reflect the natural water level that is usually present. The ratings are:

Suited - soil will support cattle when grazing

Unsuited - soil will not support cattle when grazing

Cropland Potential (see Agronomy section.) - This rating is based on several soil factors including potential acidity, salinity, thickness of organic layers, texture of the mineral layers, and ability to support dikes and levees. These factors affect management difficulty, adapted crops, and difficulty of constructing and maintaining structures for tidal storm protection.

Cropland potential is not directly related to possible yields of specific crops. It reflects in a general way the degree of development and management difficulties. The ratings for cropland potential and a brief description of the soils that comprise each group are as follows:

Cropland Potential	Description of Soils
moderate	Mineral soils with no or low salinity.
low	Organic soils with no or low salinity and high subsidence potential.
very low	Organic soils with no to moderate salinity and very high subsidence potential and mineral soils with moderate to very high salinity.

Wildlife Habitat Development Potential (see Biology section.) - Wildlife habitat development potential refers to the potential of the soil for improvement of wildlife habitat management areas. It does not reflect the productivity of a site in the unmanaged state.

Soils directly affect the feasibility of construction of water-control structures which are essential to the improvement of wetland wildlife habitats. Soils affect the potential for production of annual and perennial plants on wet sites that provide necessary food and cover for wildlife after water control structures have been installed.

If soils have the potential, wildlife habitat can be improved or created by properly managing the existing plant cover, by fostering the natural establishment of desirable plants, or by planting appropriate vegetation. In order to accomplish these improvements, the soil must have the potential for proper water management which includes water-control structures. The soil must also have the potential to produce a variety of plants that provide food and cover for wildlife.

Soil conditions that affect the installation and maintenance of water-control structures in Louisiana wetlands include presence or absence of organic layers, thickness of organic layers if present, and consistency of the mineral layers. Difficulty of protection from storm tides are not considered.

With adequate water level control, the principal soil factor that affects wetland plant production in Louisiana wetlands is soil salinity.

Soil potential for wetland wildlife development is rated good, fair, or poor.

A rating of good means the wildlife habitat can easily be improved and maintained. Few limitations affect the development and maintenance of water-control structures. Also, there is great flexibility in the plant species that can be managed for wildlife food and cover. Soils rated good have thin organic surface layers underlain by firm mineral layers or firm mineral surface layers. They have low salinity or are non-saline.

A rating of fair means that habitat can be improved and maintained fairly easily, but the choice of plants for wildlife food and cover is somewhat limited. Soils rated fair have thin organic or firm mineral surface layers and underlying mineral layers that are firm within a depth of 40 inches. They have moderate to very high salinity.

A rating of poor means that habitat improvement and maintenance of improvements are difficult or very difficult and that unsatisfactory results can sometimes be expected. Soils rated poor have moderate or thick organic surface layers or semifluid mineral surface layers that are semifluid to a depth of 40 inches or more. The salinity ranges from none to high.

Development Difficulty - Development difficulty indicates the relative degree of difficulty of reclamation of individual tracts of land. Soil factors that determine the difficulty of constructing and maintaining levees and drainage ditches are considered. Levees must provide adequate protection of urban, residential, and agricultural developments from flooding including flooding by storm tides. Development-difficulty ratings do not quantify the reclamation difficulty but are a general guide to the degree of difficulty apt to be encountered in most reclamation projects. The larger the development difficulty number the greater the problems encountered. Soils with a development difficulty of 1 are the least difficult to reclaim and those with a development difficulty of 5 are the most difficult. This rating takes into consideration only the physical characteristics of the soil that affect difficulty of local protection from flooding and drainage. It does not take into consideration the removal of salts for agricultural or other uses. The following is a list of the development difficulty and a brief description of soils in each rating:

Development Difficulty Rating	Soil Description
1	Mineral soils that are firm in all layers
2	Mineral soils that are semifluid throughout
3	Organic soils with 15 to 50 inches of organic materials over firm mineral layer
4	Organic soils with 15 to 50 inches of organic material over semifluid layers
5	Organic soils with more than 50 inches of organic material

Soil Surveys

A soil survey (Soil Survey Staff, 1951) consists of a map that shows the location and boundaries of each kind of soil, a description of each soil, how it can be expected to behave under different use and management systems, and how the soil is named and classified in a nationwide system (Soil Survey Staff, 1974). Soil series are assigned names, such as Barbary or Lafitte, for soils fitting the criteria established for them. These names

are used wherever the soils occur. Each soil has its own unique set of properties that include the kind of soil material, thickness of layers, reaction, salinity, particle size, etc. Each soil occupies a characteristic part of the landscape, and has a specific moisture regime. Soil scientists make soil surveys by field examination of soils to depths of 4 to 8 feet, at intervals close enough for reliable and accurate maps (fig. 8).

Figure 8. - Soil scientist making soil borings.

An illustration of a landscape with boundaries and soil names is given in figure 9. An example of a standard soil series description and the soil interpretations are given for the Lafitte series (Exhibit A).

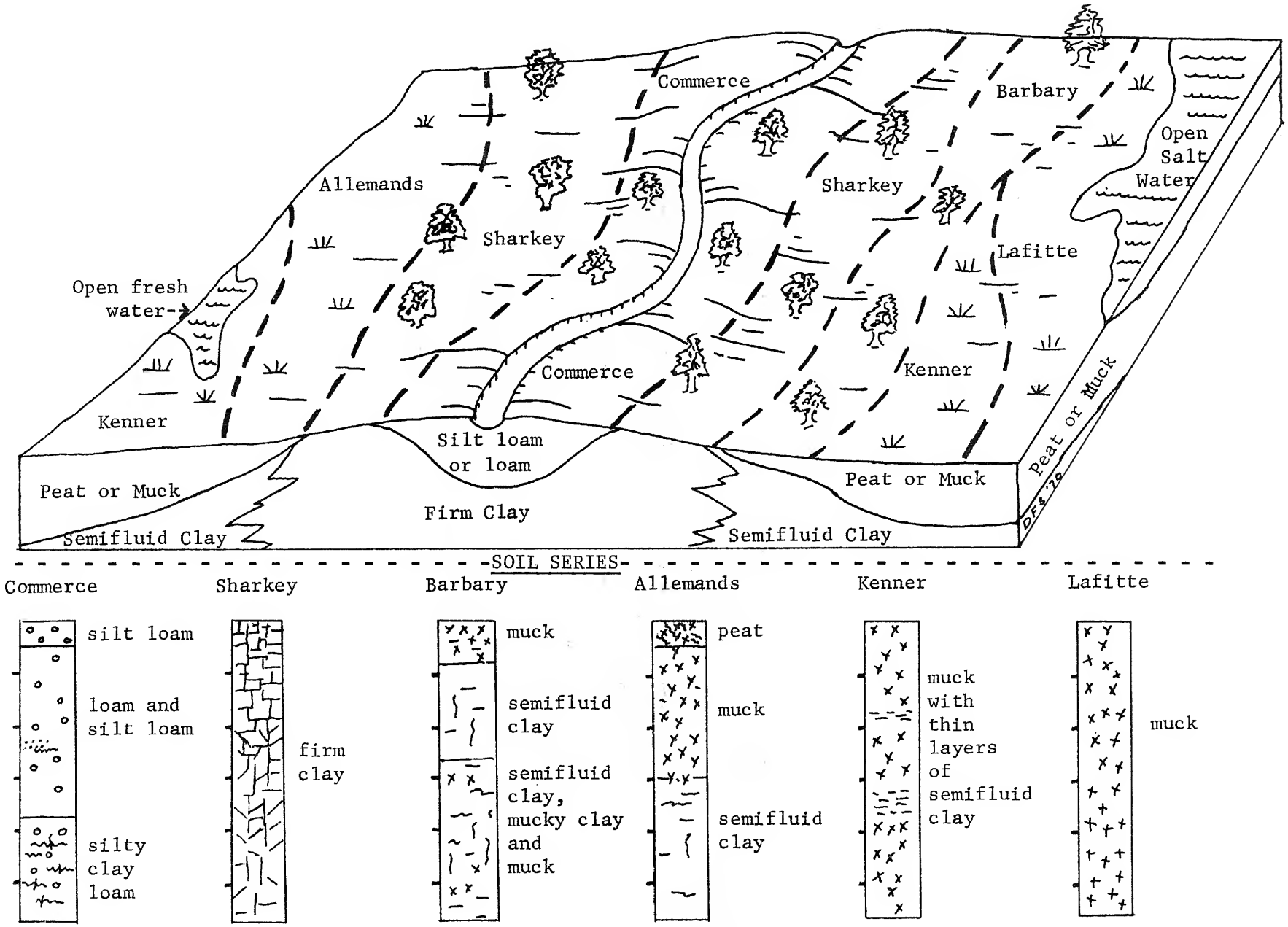


Figure 9.--Schematic relationship of soils to land form, vegetation and parent material.

Kinds of Soil Maps

The first soil survey in the Louisiana Coastal Wetlands was made in the New Orleans area in 1903. Since that time several parishwide soil surveys have been made and published and other surveys have been made of small tracts for special purposes. With each successive survey further knowledge is gained of the soils and how they behave.

Soil maps are made to meet specific needs of users. Detailed soil maps and general soil maps are two kinds that are made in the Louisiana Coastal Wetlands.

Detailed soil maps are made at scales from 1:24,000 (1 inch to 2,000 feet) to 1:15,840 (1 inch to 1,320 feet). At this scale the mapping units may include small bodies of other soils, but they are sufficiently accurate and reliable for planning use of tracts for farmland, rangeland, urban land, or wildlife land. On-site investigations are needed, however, for site selection of individual structures or for uses that require only a very few acres. Published surveys of St. Mary and Terrebonne Parishes are considered to be detailed surveys. However, the soils of the marsh were classified as miscellaneous land types, rather than named soils and therefore require some judgment or field investigation to provide the best interpretations. Soil surveys of Ascension, Iberia, Iberville, St. James, St. John, St. Martin and the recent survey of the New Orleans area are detailed surveys meeting present standards.

General soil maps have been made for all parishes at scales of approximately 1:250,000 (0.25 inches per mile). General soil maps are made by reconnaissance methods, photo interpretation, or generalization of detailed soil maps. The mapping units are typically associations of two or more dominant soils. They may include similiar or highly contrasting soils. Because of the map scale the smallest delineations are seldom less than 2,000 acres. General soil maps are best used as guides to broad land use planning such as may be needed for state, regional, or parish purposes.

Description of Soils

Twelve major kinds of soils have been encountered in soil surveys of the coastal wetlands. There are other minor soils and in, all probability, other major soils are yet to be encountered as new surveys are made in unmapped areas. Full and complete descriptions of soils similar to that for the Lafitte series (Exhibit A) have been prepared as a standard reference for classification purposes. The salinity classes contained in these descriptions

are found in the chart on page V-9. The most specific information and description of soils are prepared separately for each parish. These descriptions are in published soil surveys or in unpublished form in local Soil Conservation Service offices.

A general description of each of the major soils and some soil factors that must be considered in use and management are as follows:

Andry series - These soils have an organic surface layer about 12 inches thick over a firm loamy subsoil. They are considered to be mineral soils. The water table is at or a few inches above the surface most of the time. Trafficability is poor but the subsoil is firm enough to support cattle.

Andry soils are slightly saline to moderately saline. The vegetation is the intermediate marsh type. It is dominantly marshhay cordgrass, big cordgrass, Olney bulrush, saltmarsh bulrush, seashore paspalum, needlegrass rush and cockspur.

Andry soils are used mainly for cattle grazing and wildlife habitat. They provide excellent feeding and roosting areas for duck, geese and other waterfowl. They produce a good food supply for muskrat and nutria. Because of the firm subsoil, water-control structures for improved wildlife management are relatively easy to install and maintain. Structures necessary for good rangeland management, such as cattle walkways and fences, are also relatively easy to install and maintain.

If protected and drained - The organic surface layer will consolidate and shrink to about one-half its original thickness within a year or two after drainage. The remaining few inches will oxidize and disappear within the next few years. Subsidence potential or total loss of surface elevation after drainage is no more than about 15 inches. The surface layer will become very strongly or extremely acid after drainage.

Levees and drainage ditches are easy to construct and maintain. Reclamation for urban uses must provide adequate protection from storm tides. The firm mineral layer under the thin organic surface layer provide somewhat good foundation for low buildings, and streets, etc. The potential for cropland and pasture is very low. Reclamation for agricultural uses is generally not practical under present conditions because of potential acidity, high salt content and the high cost of protection against storm tides.

Kenner series - These soils consist of thick layers of organic materials with a few thin strata of clay. Depth to underlying mineral soil is 4 to as much as 15 feet. The water table is at or above the surface at all times unless drained. Trafficability

is poor, and when the surface-root mat is broken, the soil is too soft to support livestock. Kenner soils are in the freshwater marsh. The vegetation present is the freshwater marsh type. The vegetation is dominantly maidencane, cattail, common reed, bulrush and giant cutgrass.

Kenner soils are used mainly for wildlife habitat. They provide feeding and roosting areas for ducks, geese and other waterfowl. They produce an excellent food supply for nutria. Water-control structures to improve wildlife management are difficult to install and maintain due to instability of the organic material.

If protected and drained - Kenner soils will consolidate and shrink more than 3 feet during the first year or two after drainage. Potential subsidence is 4 to 15 feet. As a result of oxidation of organic material, these soils will gradually subside to the water table or underlying mineral soil. Elevations below sea level are likely to occur due to subsidence. The organic layers may catch fire and burn when dry. Kenner soils become acid after drainage. They have very low potential for cropland or pastureland. Reclamation for agriculture is generally not practical. Drainage ditches and levees are difficult to construct because of instability and compressibility of the organic layers. Levees constructed of the organic materials shrink and wide cracks form (fig. 2). The capacity of ditches is gradually reduced because of the continual subsidence of the organic material. Flooding may occur if pumps or levees fail. Piling are generally needed to support most structures. Sidewalks, driveways, porches, underground utilities, and other structures not supported by pilings will be damaged by subsidence, causing high maintenance costs.

Allemands series - These soils have an organic surface layer 16 to 50 inches thick over a semifluid, clayey layer. They are considered to be organic soils. The water table is always at or a few inches above the surface.

Trafficability is poor, and when the surface-root mat is broken, this soil is too soft to support livestock grazing.

Allemands soils are in the fresh marshes. The vegetation is freshwater marsh type. Typical vegetation includes maidencane, cattail, common reed, bulrush and giant cutgrass.

These soils are used mainly for wildlife habitat. When flooded Allemands soils provide roosting and feeding areas for ducks, geese, and other waterfowl. They also provide a good food supply for nutria. Water-control structures for intensive wildlife management are difficult to construct and maintain because of the instability of the organic material.

If protected and drained - Allemands soils consolidate, shrink, and lose about 1 to 2 feet surface elevation the first year or two after drainage. Subsidence will continue at a rate of one-half inch to two inches per year until the mineral soil or water table is reached. The surface will recede with subsidence to elevations that are below sea level in most places. Potential subsidence is 16 to 50 inches. Allemands soils become acid after drainage but they have a low potential for cropland and pastureland. Levees and ditches are difficult to construct and maintain because of the instability of the organic material and the semifluid nature of the mineral layers. Levees constructed of organic material shrink and wide cracks form. The capacity of drainage ditches is gradually reduced by subsidence until all of the organic material is oxidized. Pilings are needed to support foundations for most structures. Maintenance cost of urban and residential development is high due to damage to sidewalks, driveways, porches, underground utilities, and other structures by subsidence. If pumps or levees fail, flooding will occur.

Barbary series - These soils have an organic surface layer about 6 inches thick over semifluid, clayey subsurface layers. The water table is always at or a few inches above the surface. Trafficability is very poor. The semifluid layer makes human foot traffic difficult. The subsurface layer contains strata high in wood, logs, and stumps.

Barbary soils have no or low salinity. Their vegetation is swamp type. Dominant overstory is baldcypress, water tupelo and Drummond red maple. Typical understory and aquatic vegetation includes smartweed, alligatorweed, butterweed, buttonbush, sedge, duckweed and waterhyacinth.

Barbary soils are used mainly for timber production and wildlife habitat. The potential woodland production is moderate. The forest type is baldcypress and water tupelo. The site index is 60 for water tupelo. Special equipment is needed for timber harvesting operation. These soils provide roosting areas and a limited food supply for ducks and other waterfowl. A limited number of turkeys roost in the area. They also provide a food supply for deer and squirrel and habitat suitable for mink, alligators, crawfish, and raccoon. Structures for controlling water level that are necessary for intensive wildlife management are somewhat difficult to construct and maintain due to the semifluid nature of the clay.

If protected and drained - Barbary soils will consolidate and shrink when drained. Potential subsidence is about 5 to 12 inches and is not considered a serious problem. After drainage, the semifluid layer above the water table becomes firm and cracks will develop. The cracks will not close when soil is rewet. Drainage

ditches and levees are difficult to construct because of the semifluid nature of the mineral layers and the presence of logs and stumps. Pilings are generally needed to support most structures because of the semifluid nature of the underlying layers. The potential for cropland and pasture is moderate. Wetness difficulty in cultivating and equipment limitation are the main problems when Barbary soils are used for agricultural purposes.

Carlin series - These soils consist of thick organic materials with the surface layer floating on a layer of water. Thickness of organic materials range from 51 to 150 inches or more. Thickness of the water layer varies with the water level in adjacent bodies of water, which results in a fluctuating surface elevation. The water table is at the surface at all times. Where the surface-root mat has been removed, open water areas are created. Trafficability is very poor, and the soil is too soft to support livestock.

Carlin soils are in the fresh marshes. The vegetation present is freshwater marsh type. The vegetation is dominantly maidencane, waterhyacinth, rice cutgrass, cattail, plumegrass and waterprimrose.

Carlin soils are used for wildlife habitat. They provide roosting areas and a limited food supply for ducks, geese and other waterfowl. They also provide excellent habitat for furbearers and alligators. Water-control structures for intensive wildlife management are extremely difficult to install because of the water layer and the unstable nature of the organic material.

If protected and drained - Carlin soils will consolidate and shrink. This consolidation of the organic material and the loss of the water layer will result in a 3- to 4-foot reduction in surface elevation the first year or two after drainage. As a result of oxidation of the organic materials, these soils will gradually subside to the water table or the underlying mineral soil. Total subsidence potential is about 4 to 15 feet which, in most cases, will result in surface elevations below sea level. Carlin soils become acid after drainage. They have a very low potential for cropland and pasture. Reclamation for agriculture is generally not practical. Levees constructed of the organic material shrink, and wide cracks develop. The capacity of drainage ditches is gradually reduced because of the continual subsidence of the organic material. Pilings are needed to support most structures. Sidewalks, driveways, porches, underground utilities, and other structures not supported by pilings will be damaged by subsidence, causing high maintenance costs. Flooding will occur if pumps or levees fail.

Delcomb series - These soils have an organic surface layer 18 to 50 inches thick over a firm loamy subsoil. They are considered to be organic soils. The water table is always at or a few inches

above the surface. Areas of open, shallow surface water occur throughout most of the area.

Trafficability is poor, and when the surface-root mat is broken, the soil is too soft to support cattle.

The salinity of Delcomb soils is moderate or high. Vegetation is intermediate or brackish marsh types. Vegetation is dominantly marshhay cordgrass, needlegrass rush, saltmarsh bulrush, Olney bulrush and big cordgrass.

Delcomb soils are used mainly for wildlife habitat. They produce a good food supply for muskrat. When flooded with a few inches of water, they also produce excellent feeding and roosting areas for duck, geese, and other waterfowl. Water-control structures for improved wildlife management are somewhat difficult to construct and maintain because of the instability of the organic layers.

If protected and drained - Delcomb soils consolidate, shrink, and lose about 1 to 2 feet of surface elevation the first year or two after drainage. Subsidence will continue to the water table or until the underlying mineral soil is reached. Potential subsidence is 16 to 50 inches. Surface elevation is likely to recede to below sea level due to subsidence. Delcomb soils become more acid after drainage but they have a very low potential for cropland and pasture. Reclamation for agriculture is generally not practical. Drainage ditches and levees are somewhat difficult to construct and maintain because of instability and compressibility of the organic layer. Levees constructed of the organic materials shrink and wide cracks develop. The capacity of ditches is gradually reduced until all of the organic material is oxidized. If pumps or levees fail, flooding may occur. The firm loamy mineral layer underlying the organic material will generally support structures such as roads and low buildings. During the process of subsidence, sidewalks, driveways, porches, and other structures placed on the organic layers are damaged. Maintenance cost of these structures is high until the organic materials have oxidized.

Fausse series - These soils have firm, clayey surface and subsurface layers. The water table is always from one and one-half feet below the surface to several feet above the surface.

Fausse soils are in broad, low deltaic swamps. Salinity is none or slight. The overstory vegetation is dominantly baldcypress, water tupelo, pumpkin ash and water-elm. Typical understory and aquatic vegetation includes buttonbush, swamp-privet, hibiscus, waterhyacinth, duckweed, Ammannia and lizardtail.

Fausse soils are used mainly for timber production and wildlife habitat. The potential for hardwood timber production is moderate. While flooded, Fausse soils provide roosting areas and a limited food supply for duck and other waterfowl. A limited number of turkeys roost in the area. They provide a limited food supply for deer and squirrels and a habitat for crayfish, alligators, mink, and raccoons. Intensive wildlife management practices require structures for controlling water levels. These structures are not difficult to construct and maintain on Fausse soils.

If protected and drained - Fausse soils remain stable and do not subside after drainage. Drainage ditches and levees are fairly easy to construct and maintain. Fausse soils after drainage provide adequate support for levees, dwellings, roads, etc. Foundations for dwellings generally do not require pilings. The main problem for most urban uses are high shrink-swell potential and wetness.

Fausse soils have moderate potential for cropland and pasture-land. When used for agricultural purposes, the main problems are wetness and difficulty in cultivating due to the clayey surface layers.

Gentilly series - These soils have an organic surface layer 4 to 15 inches over a semifluid, clayey layer. The semifluid layer is underlain by a firm, clay layer at 24 to 40 inches below the mineral surface. Gentilly soils are considered mineral soils. The water table is at or a few inches above the surface all the time.

Trafficability is poor, and the soil is too soft to support cattle when grazing.

The salinity of Gentilly soils is low or moderate. The vegetation is the intermediate marsh type. Typical plants include marshhay cordgrass, big cordgrass, common reed, and bulltongue.

Gentilly soils are used mainly for wildlife habitat. They produce a good food supply for muskrat and nutria. When flooded Gentilly soils produce excellent feeding and roosting areas for duck, geese, and other waterfowl. Because of the semifluid upper mineral layer, levees and other structures for intensive wildlife management are somewhat difficult to construct and maintain.

If protected and drained - The organic surface will consolidate and shrink to about one-half its original thickness the first year or two after drainage. The remaining few inches will oxidize and disappear within the next few years. Subsidence potential is low and the total loss of surface elevation is no more than about 15 inches. When the semifluid, clayey layer dries after drainage, it consolidates and becomes firm. Consequently, Gentilly soils are firm throughout after drainage.

Storm-tide levees and drainage ditches are fairly easy to construct and maintain. Reclamation for urban uses must provide adequate protection from storm tides. If levees or pumps fail, flooding will occur. The firm clayey layers provide fair foundations for low buildings, streets, etc. The potential for cropland and pastureland is very low. Reclamation for agricultural uses is generally not practical under present conditions due to the high cost of protection against storm tides.

Harris series - These soils have firm clayey layers to a depth of 40 inches or more. The water table ranges from two feet below the surface to a few inches above the surface all the time.

Salinity is moderate or high. The vegetation is either intermediate or brackish marsh types. Typical plants include marshhay cordgrass, common reed and seashore saltgrass.

Harris soils are used mainly for cattle grazing and wildlife habitat. While flooded, Harris soils provide roosting areas and a limited food supply for ducks, geese, and other waterfowl. They produce a good food supply for muskrat. Structure for good rangeland management such as fences and cattle walkways are fairly easy to install and maintain. Structures for water level control such as levees are also easy to install and maintain.

If protected and drained - Harris soils remain stable and do not subside after drainage. Drainage ditches and levees are easy to construct and maintain. Harris soils provide adequate support for foundations for houses, roads, levees, etc. Consequently, foundations for dwellings generally do not require pilings. The main problems for most urban uses are wetness, high shrink-swell potential, and salinity.

Harris soils have very low potential for cropland and pastureland. The main problems for agricultural production are salinity, wetness and difficulty in cultivating due to the clayey surface.

Harris Varient, Non-Saline 1/ - These soils have firm clayey layers to a depth of 40 inches or more. The water table always ranges from two feet below the surface to a few inches above the surface all the time.

Salinity is none or low. The vegetation is typically of the freshwater marsh type. Typical plants include maidencane, cattail, common reed, bulrush and giant cutgrass.

1/ These soils are similar to the Harris series but they have lower salinity. When sufficient data are available, a series concept will be developed for these soils.

These soils are used mainly for cattle grazing and wildlife habitat. When flooded, Harris soils provide roosting areas and a good food supply for duck, geese and other waterfowl. They produce a good food supply for nutria and muskrat. Structures for rangeland management such as fences and cattle walkways are fairly easy to install and maintain. Structures for water level control such as levees are also easy to install and maintain. A small acreage of these soils, mainly areas adjacent to the higher lying terraces have been protected from flooding and are being used for cropland and pastureland.

If protected and drained - Harris non-saline varient soils remain stable and do not subside after drainage. Drainage ditches and levees are easy to construct and maintain. These soils provide adequate support for foundations for houses, roads, levees, etc. Consequently, foundations for dwellings generally do not require pilings. The main problems for most urban uses are wetness and high shrink-swell potential.

These soils have moderate potential for cropland and pastureland. The main problems for agricultural production are maintaining adequate protection from storm tides, and wetness and difficulty in cultivating due to the clayey surface.

Lafitte series - These soils consist of organic materials to a depth of 50 inches or more. The underlying mineral layers are typically semifluid clay. The water table is always at or a few inches above the surface.

Trafficability is poor, and the soil is too soft to support livestock.

The salinity of the Lafitte soils is moderate or high, and the vegetation is characteristically intermediate or brackish marsh type. Vegetation is dominantly marshhay cordgrass, needlegrass rush, saltmarsh bulrush, Olney bulrush, big cordgrass, and seashore paspalum.

Lafitte soils are used mainly for wildlife habitat. They produce a good food supply for muskrat and geese. Lafitte soils also produce roosting areas and an excellent food supply for ducks and other marsh birds. Structures for control of water levels that are needed for intensive wildlife management are difficult to construct and maintain because of the unstable nature of the organic layers.

If protected and drained - Lafitte soils will consolidate, shrink, and lose about three feet of surface elevation the first year or two after drainage. Subsidence will continue until the water table or underlying mineral layer is reached. Total subsidence potential is very high.

Lafitte soils become more acid after drainage. They have a very low potential for cropland and pastureland. Reclamation for agricultural purposes is generally not practical. Levees and drainage ditches are difficult to construct and maintain because of instability and compressibility of the organic material. Levees constructed of the organic materials shrink, and wide cracks develop. The capacity of the drainage ditches is reduced by subsidence until all of the organic materials have oxidized. Flooding will occur if pumps or levees fail.

Pilings are generally needed to support most structures. Sidewalks, driveways, porches, and other structures not supported by pilings will be damaged by subsidence. Maintenance costs of the structures are high.

Maurepas series - These soils consist of organic material with many logs and stumps to a depth of 50 to 150 inches. The underlying layers are semifluid clay. The water table is at or up to 2 feet above the surface most of the time.

Trafficability is very poor due to the nearly fluid nature of the organic material and the presence of logs and stumps.

Maurepas soils are in the freshwater swamps. The overstory vegetation is mainly baldcypress and water tupelo. The understory and aquatic vegetation includes buttonbush, alligatorweed, and duckweed.

These soils are used mainly for very limited timber production and wildlife habitat. The potential for wood production is low. Maurepas soils provide roosting areas and a limited food supply for ducks. They provide excellent habitat for furbearers and alligators.

If protected and drained - Maurepas soils will consolidate, shrink and lose about 3 feet of surface elevation the first year or two after drainage. Subsidence will continue until the underlying mineral layer or the water table is reached. Total subsidence potential is 50 to 150 inches. As a result of subsidence, surface elevation in many cases will recede to below sea level. Maurepas soils become more acid after drainage. They have a very low potential for cropland and pastureland. Reclamation for agricultural uses is generally not practical. Drainage ditches and levees are extremely difficult to construct and maintain because of the numerous logs and stumps and the instability and compressibility of the organic material. Levees constructed of the organic material develop large cracks as the result of shrinkage. The capacity of drainage ditches is gradually reduced until the water table or mineral soil surface is reached.

Differential settling due to buried logs and stumps will result in damage to levees, roads and other structures not supported by pilings. If pumps or levees fail, flooding will occur.

Pilings are required to support most structures. Sidewalks, driveways, porches, underground utilities, and other structures not supported by pilings will be damaged by subsidence. Maintenance costs of the structures are high.

Placedo series - These soils have firm, clayey layers to a depth of 60 inches or more. The water table always ranges from one foot below the soil surface to a few inches above the surface.

Salinity is moderate or high. The vegetation is characteristic of either the intermediate or brackish marsh types. Typical plants include marshhay cordgrass, common reed, and seashore saltgrass.

Placedo soils are used mainly for cattle grazing and wildlife habitat. While flooded, Placedo soils provide roosting areas and a limited food supply for ducks, geese, and other waterfowl. They produce a good food supply for muskrat. Structures for good rangeland management such as fences and cattle walkways are fairly easy to install and maintain. Structures for water level control such as levees are also easy to install and maintain.

If protected and drained - Placedo soils remain stable and do not subside after drainage. Drainage ditches and levees are easy to construct and maintain. Placedo soils provide adequate support for foundations for houses, roads, levees, etc. Consequently, foundations for dwellings generally do not require pilings. The main problems for most urban uses are wetness, high shrink-swell potential and salinity.

Placedo soils have a poor potential for cropland and pastureland. The main problems for agricultural uses are salinity, wetness, and difficulty in cultivating due to the clayey surface.

Scatlake series - These soils have semifluid, clayey layers to a depth of 60 inches or more. The water table is always at the surface to a few inches above the surface.

Salinity is moderate or high, and the vegetation is either intermediate or brackish marsh types. Typical plants include marshhay cordgrass, common reed and seashore saltgrass, big cordgrass, needlegrass rush, and Olney bulrush.

Scatlake soils are used mainly for wildlife habitat. While flooded they provide roosting areas and fair food supply for ducks, geese, and other waterfowl. They produce a good food supply

for muskrat. Structures for water level control such as levees are difficult to install and maintain because of the semifluid nature of the mineral layers.

If protected and drained - Scatlake soils will consolidate and shrink when drained. Potential subsidence is about 5 to 12 inches and is not considered a serious problem. After drainage, the semifluid layer above the water table becomes firm, and cracks will develop. The cracks will not close when soil is rewet. Drainage ditches and levees are difficult to construct because of the semifluid nature of the mineral layers. Pilings are needed to support most structures because of the semifluid nature of the underlying layers. Scatlake soils have very poor potential for cropland and pastureland. Reclamation for agricultural uses is generally not practical. Wetness, high salt content, and difficulty in cultivating are the main problems when Scatlake soils are used for agricultural purposes.

EXHIBIT A

Established Series
Rev. WLC:SDM
4/73

LAFITTE SERIES

The Lafitte series is a member of the euic, thermic family of Typic Medisaprists. (See Remarks) These soils have thick layers of well decomposed herbaceous organic materials. They are underlain below 51 inches by semifluid clayey layers.

Typifying Pedon: Lafitte muck - coastal marsh.
(Colors are for broken face of moist soil unless otherwise stated.)

Oa1 -- 0-6" -- Very dark brown (10YR 2/2) sapric material, same color pressed and rubbed; about 5 percent fiber, less than 1 percent rubbed; weak coarse subangular blocky structure; flows with difficulty between fingers when squeezed leaving small residue in hand; many fine live roots; dominantly herbaceous fiber; about 50 percent mineral; few very dark reddish brown (5YR 3/4) fragments of woody fiber; moderately alkaline; gradual smooth boundary. (0 to 12 inches thick)

Oa2 -- 6-16" -- Black (10YR 2/1) sapric material, same color pressed and rubbed; about 6 percent fiber, 1 to 2 percent rubbed; weak medium granular structure; flows with slight difficulty between fingers when squeezed leaving a small residue in hand; dominantly herbaceous fiber; about 20 percent mineral; moderately alkaline; gradual smooth boundary. (5 to 20 inches thick)

Oa3 -- 16-30" -- Black (10YR 2/1) sapric material, same color pressed and rubbed; about 3 percent fiber, less than 1 percent rubbed; weak fine granular structure; flows easily between fingers when squeezed leaving a very small residue in hand; dominantly herbaceous fiber; about 20 percent mineral; moderately alkaline; gradual smooth boundary. (10 to 20 inches thick)

Oa4 -- 30-48" -- Black (10YR 2/1) sapric material, same color pressed and rubbed; about 5 percent fiber, 1 percent rubbed; weak fine granular structure; flows with difficulty between fingers when squeezed leaving large residue in hand; about 25 percent mineral; moderately alkaline; clear smooth boundary. (10 to 40 inches thick)

Oa5 -- 48-52" -- Black (10YR 2/1) sapric material, same color pressed and rubbed; about 8 percent fiber, 2 percent rubbed; weak coarse subangular blocky structure; flows with difficulty through fingers when squeezed leaving large residue in hand; dominantly herbaceous fiber; about 30 percent mineral; moderately alkaline. (10 to 25 inches thick)

Oa6 -- 52-75" -- Very dark brown (10YR 2/2) sapric material, same color pressed, dark reddish brown (5YR 3/2) rubbed; about 20 percent fiber, 5 percent rubbed; weak coarse granular structure; flows easily between fingers when squeezed leaving a large residue in hand; dominantly herbaceous fiber; about 55 percent mineral; moderately alkaline; abrupt smooth boundary. (10 to 30 inches thick)

IIAlg -- 75-90" -- Dark grayish brown (2.5Y 4/2) clay; massive; soft when wet; sticky; flows between fingers with slight difficulty when squeezed leaving hand empty; moderately alkaline; abrupt smooth boundary. (0 to 50 inches thick)

IICIg -- 90-100" -- Gray (N 6/) plastic clay; massive; flows easily through fingers when squeezed leaving hand empty; moderately alkaline. (20 to 50 inches thick)

Type Location: Orleans Parish, Louisiana; three and four-tenths miles east of junction of Louisiana Highway 47 and Interstate 10, T. 11 S., R. 13 E.

Range in Characteristics: Depth to clayey mineral layers ranges from 51 inches to over 100 inches. The sodium adsorption ratio in the subsurface tier (12 to 36 inches) ranges from 12 to 18, and the exchangeable sodium percentage ranges from 8 to 27. The average conductivity of the saturation extract ranges from 6 to 16 (mmhos/cm) in the surface tier (0 to 12 inches) and from 8 to 16 in the subsurface and bottom tiers. The organic materials in the surface tier (0 to 12 inches) are black (10YR 2/1), dark brown (10YR 4/3; 7.5YR 3/2), very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), dark gray (10YR 4/1), or very dark brown (10YR 2/2) and fiber

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content after rubbing ranges from 1 to 35 percent. The surface tier ranges from slightly acid through moderately alkaline when undrained, and from extremely acid through strongly acid when drained. Some pedons have mineral overwash layers 2 to 10 inches thick in this tier. The organic materials in the subsurface tier (12 to 36 inches) and the bottom tier (36 to 51 inches) are black (10YR 2/1), very dark brown (10YR 2/2), very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or dark brown (7.5YR 3/2). Rubbed fiber content averages between 1 to 10 percent of the organic volume. The subsurface and bottom tiers are slightly acid through moderately alkaline when undrained, and extremely acid through medium acid after drainage. The sodium adsorption ratio is more than 13; the exchangeable sodium percentage is more than 15 and the salinity is moderate or high in some or all layers within these tiers. The IIA and IIC horizons are gray (5Y 5/1), dark gray (5Y 4/1), dark greenish gray (5GY 4/1), or greenish gray (5GY 5/1) semifluid clay or silty clay. They are neutral through moderately alkaline.

Competing Series and their Differentiae: These are the Dare, Dorovan, Kenner, Maurepas, and Terra Ceia series. In the undrained condition, the Dare and Dorovan series have pH values of less than 5.5 in all parts of the control section, and in addition have SAR $<$ 13 or ESP $<$ 15. The Terra Ceia soils have a mean annual temperature of more than 72° F. Kenner soils have strata of clayey material less than 12 inches thick between depths of 12 and 51 inches. The Maurepas series has redder hues, and is developed from dominantly woody materials.

Setting: Lafitte soils are in large areas of saline marshes in the extreme lower Mississippi River delta and coastal areas. They commonly adjoin large salt water lakes. Elevations are typically one foot above mean sea level to about 3 feet below. Lafitte soils formed in herbaceous plant remains that overlie clayey sediments. The climate is humid subtropical. Mean annual precipitation is about 65 inches and the mean annual temperature is about 68° F., near the type location.

Principal Associated Soils: These are the competing Kenner and Maurepas series and the Allemands and Gentilly series. The Gentilly series is a mineral soil. The Allemands series has mineral layers within 51 inches of the surface. All of these are on the landward side of the Lafitte series, and are less saline.

Drainage and Permeability: Very poorly drained; the water table ranges 1 foot above to .5 foot below the surface unless protected and pumped. Internal drainage is very slow to none. Permeability is rapid.

Vegetation and Use: The main use of these soils is wildlife habitat. Some acreage is protected by dikes and pumps and used for urban development. The dominant vegetation is cattail, marshhay cordgrass, big cordgrass, salt marsh bulrush, and bulrush.

Distribution and Extent: Coastal areas of Louisiana and possibly Mississippi, Alabama, Georgia, South Carolina, and North Carolina. Extent is moderate.

Series Established: Orleans Parish, Louisiana; 1972.

Remarks: When described, the water level at the type location was 8 inches above the surface. Where protected from flooding and drained, these soils subside until organic layers are oxidized and become extremely to strongly acid. Under the 1938 classification, these soils would be classified as Bog soils. The subgroup, Typic Halasaprists has been proposed for soils such as those of the Lafitte series.

National Cooperative Soil Survey
U. S. A.

MLRA(S): 151
REV. LLL, 7-75
TYPIC MEDISAPRISTS, ELIC, THERMIC

LAFITTE SERIES

THE LAFITTE SERIES CONSISTS OF LEVEL, VERY POORLY DRAINED, RAPIDLY PERMEABLE SOILS. THEY HAVE AN ORGANIC LAYER MORE THAN 51 INCHES THICK OVER GRAY SEMIFLUID CLAY. THESE SOILS FORMED IN HERBACEOUS PLANT REMAINS THAT OVERLIE CLAYEY SEDIMENTS. THEY OCCUR IN SLIGHTLY SALINE MARSHES ADJACENT TO THE GULF OF MEXICO. ELEVATION IS NEAR SEA LEVEL. SLOPES ARE LESS THAN .1 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USCA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-75	SF	PT	A-8	0	-	-	-	-	-	-
75-80	C	MH, CH	A-7-5	0	100	100	85-95	80-95	60-105	30-65

DEPTH (IN.)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	CORROSIVITY STEEL	CORROSIVITY CONCRETE	EROSION FACTORS K	EROSION FACTORS T	WIND EROD. GROUP
0-75	>2.0	>.20	6.1-8.4	6-16	LOW	HIGH	MODERATE	-	-	-
75-80	<0.06	0.10-0.15	6.1-8.4	8-16	HIGH	HIGH	MODERATE	.32		

FLOODING FREQUENCY	FLOODING DURATION	HIGH WATER TABLE DEPTH (FT)	HIGH WATER TABLE KIND	HIGH WATER TABLE MONTHS	CEMENTED PAN DEPTH (IN)	CEMENTED PAN HARDNESS	BEDROCK DEPTH (IN)	BEDROCK HARDNESS	SUBSIDENCE INIT. (IN)	SUBSIDENCE TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
COMMON	BRIEF-LONG	JAN-DEC	+1-0.5	APPARENT	JAN-DEC	-	>60	-	-	>51	D	-

SANITARY FACILITIES (A)

SEPTIC TANK ABSORPTION FIELDS	COMMON: SEVERE-FLOODS,WETNESS PROTECTED: SEVERE-WETNESS
SEWAGE LAGOON AREAS	COMMON: SEVERE-FLOODS,SEEPAGE,EXCESS HUMUS PROTECTED: SEVERE-WETNESS,SEEPAGE, EXCESS HUMUS
SANITARY LANDFILL (TRENCH)	COMMON: SEVERE-FLOODS,WETNESS,EXCESS HUMUS PROTECTED: SEVERE-WETNESS,SEEPAGE, EXCESS HUMUS
SANITARY LANDFILL (AREA)	COMMON: SEVERE-FLOODS,WETNESS,SEEPAGE PROTECTED: SEVERE-WETNESS,SEEPAGE
DAILY COVER FOR LANDFILL	POOR-WETNESS,EXCESS HUMUS

COMMUNITY DEVELOPMENT (A)

SHALLOW EXCAVATIONS	COMMON: SEVERE-FLOODS,CUTBANKS CAVE,WETNESS PROTECTED: SEVERE-CUTBANKS CAVE,WETNESS
DWELLINGS WITHOUT BASEMENTS	COMMON: SEVERE-FLOODS,EXCESS HUMUS, LOW STRENGTH PROTECTED: SEVERE-EXCESS HUMUS,WETNESS, LOW STRENGTH
DWELLINGS WITH BASEMENTS	COMMON: SEVERE-FLOODS,EXCESS HUMUS, LOW STRENGTH PROTECTED: SEVERE-EXCESS HUMUS,LOW STRENGTH, WETNESS
SMALL COMMERCIAL BUILDINGS	COMMON: SEVERE-FLOODS,EXCESS HUMUS, LOW STRENGTH PROTECTED: SEVERE-EXCESS HUMUS,LOW STRENGTH, WETNESS
LOCAL ROADS AND STREETS	COMMON: SEVERE-FLOODS,EXCESS HUMUS, LOW STRENGTH PROTECTED: SEVERE-EXCESS HUMUS,LOW STRENGTH, WETNESS
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	

SOURCE MATERIAL (A)

ROADFILL	POOR-LOW STRENGTH,WETNESS,EXCESS HUMUS
SAND	UNSUITED-EXCESS HUMUS
GRAVEL	UNSUITED-EXCESS HUMUS
TOPSOIL	POOR-WETNESS,EXCESS HUMUS

WATER MANAGEMENT

POND RESERVOIR AREA 2	SEVERE-SEEPAGE
EMBANKMENTS DIKES AND LEVEES 2	SEVERE-UNSTABLE FILL,EXCESS HUMUS, LOW STRENGTH
EXCAVATED PONDS AQUIFER FED 2	SLIGHT
DRAINAGE	COMMON: CUTBANKS CAVE,FLOODS PROTECTED: CUTBANKS CAVE
IRRIGATION	COMMON: NOT NEEDED PROTECTED: SEEPAGE,WETNESS
TERRACES AND DIVERSIONS	NOT NEEDED
GRASSED WATERWAYS	COMMON: NOT NEEDED PROTECTED: WETNESS

REGIONAL INTERPRETATIONS

LAFITTE SERIES

LA0012

RECREATION (8)

CAMP AREAS	COMMON: SEVERE-FLOODS,WETNESS,EXCESS HUMUS PROTECTED: SEVERE-WETNESS,EXCESS HUMUS	PLAYGROUNDS	COMMON: SEVERE-FLOODS,WETNESS,EXCESS HUMUS PROTECTED: SEVERE-WETNESS,EXCESS HUMUS
PICNIC AREAS	COMMON: SEVERE-FLOODS,WETNESS,EXCESS HUMUS PROTECTED: SEVERE-WETNESS,EXCESS HUMUS	PATHS AND TRAILS	COMMON: SEVERE-FLOODS,WETNESS,EXCESS HUMUS PROTECTED: SEVERE-WETNESS,EXCESS HUMUS

CAPABILITY AND PREDICTED YIELDS -- CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		COMMON BERMUDAGRASS (ALM)													
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
COMMON	6W		-													
PROTECTED	4W		10													

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	CRD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: IMPORTANT TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMIN'G PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (3)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	V. POOR	V. POOR	V. POOR	-	-	-	GOOD	V. POOR	V. POOR	-	GOOD	-

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSEN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE				
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS						
NORMAL YEARS						
UNFAVORABLE YEARS						

FOOTNOTES

A RATINGS BASED ON "GUIDE FOR INTERPRETING ENGINEERING USES OF SOILS", 11/71.
B RECREATION RATINGS BASED ON SOILS MEMORANDUM-69, 10/68.
1 MAY POLLUTE GROUND WATER.
2 RATINGS BASED ON SRWPC COMMITTEE IV DRAFT, 4/70.
3 WETLAND PLANTS AND WETLAND WILDLIFE RATED UNDER NATURAL UNMANAGED CONDITIONS FOR COMMON FLOODED PHASE.

SECTION VI

WOODLAND

General

There are two soils that produce commercial timber in the Gulf Coast wetlands. They are Fausse clay, which is in Woodland Suitability Group 3w6, and Barbary muck, which is in Woodland Suitability Group 4w6.

The Fausse clay produces a wider variety of trees and has a higher productivity rating than Barbary muck. Baldcypress and water tupelo are the dominant species growing on both of these soils. However, on the higher elevations of the Fausse clay there are green and pumpkin ash, black willow, pecan, honeylocust, sweetgum, water oak and red maple. On the Barbary muck there is some red maple in addition to the baldcypress and water tupelo.

Practice Specification

As hardwood trees are very susceptible to fire, caution should be exercised to prevent wildfire during extreme dry seasons.

Construction of access roads are desirable. These roads help in timber management operations, harvest cutting, and access to the area for fire control, hunting and fishing. Road construction is expensive on either of these soils. However, it is more economical to construct roads on Fausse clay than on Barbary muck.

Fencing to exclude livestock is essential for establishing desirable hardwood reproduction. Regeneration is usually from root sprouts and seeds being deposited on mounds, tree uplifts, and stumps. Severe logging conditions, due to wetness, usually account for heavy, infrequent harvest cutting. Very little woodland improvement is ever done because of the low economic returns and difficulty of trafficability.

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GULF COAST WETLANDS HANDBOOK
SUPPLEMENT NO. 1

Re: SCS Assistance Involving Gulf Coast Marsh

Soil Conservation Service assistance will be extended to soil and water conservation district cooperators and Agricultural Conservation Program participants in planning and applying soil, water, and plant conservation measures on marshlands. This will include assistance on cropland, tame pasture, range, recreation, and wildlife areas.

Where requests for assistance include converting marshlands to cropland, or where drainage is involved, Biology Memorandum LA-3,(Rev-2), dated July 8, 1977, and Conservation Planning Memorandum SCS-15, dated May 5, 1975, will be followed.

Often marsh assistance involves complications of various degrees. These may include coordination of range and wildlife use, extensive water control, proposed land use changes, and others. When requests for assistance include such complications, the area conservationist or district conservationist may deem it necessary to conduct a marsh evaluation survey. These evaluations will include a soil survey for determinations of land use capability, wildlife values, range values, alternate land use and treatments, and desires of the landowner. The following outline will be used in making the evaluation survey report. All points must be covered. If any item does not apply on a particular project, simply state "Does not apply" opposite the outline heading.

OUTLINE FOR EVALUATION SURVEY REPORT

I. Introduction. Include name of applicant; acres, types, and location of marsh; and members of survey party.

II. Present operations. Describe use of marsh area and how it fits into overall operation at present time.

III. Proposed treatment. Explain what landowner wants to do with marsh.

IV. Soils, soil map, narrative description, and capability classification, if in cropland.

V. Vegetation. List major plants, range site and conditon, wildlife site and condition.

VI. Wildlife values. Include information of furbearers, wildfowl, trapping and hunting.

VII. Range grazing values where applicable. Include seasonal use, economic value, and how the forage resource ties in with the overall operation.

VIII. Engineering feasibility.

IX. Statement on economic value (both before and after the change).

X. Conclusions and recommendations. On items II-VIII, give team recommendations. Additional remarks may be added by the area conservationist.

An overlay or sketch indicating land use and the appropriate soils interpretations such as: land capabilities, wildlife site, range site and condition, and proposed land use changes will accompany all copies of the report.

The survey will be made by the district conservationist, soil scientist, and agricultural engineer working as a team. After the field evaluation has been made, the district conservationist will prepare three copies of a written report of each survey. The original, which is retained by the district conservationist, should be filed with the farmer-district agreement. The other two copies should be forwarded to the area conservationist for review. The area conservationist will retain one copy and forward the other to the state office.

When marsh planning is not complicated, a formal marsh evaluation survey will not be made. However, the necessary range, wildlife, engineering, or other needed surveys will be made for planning purposes. When deemed necessary, the district conservationist will request through the area conservationist the assistance of the state wildlife biologist and the state range conservationist in making the marsh evaluation survey.